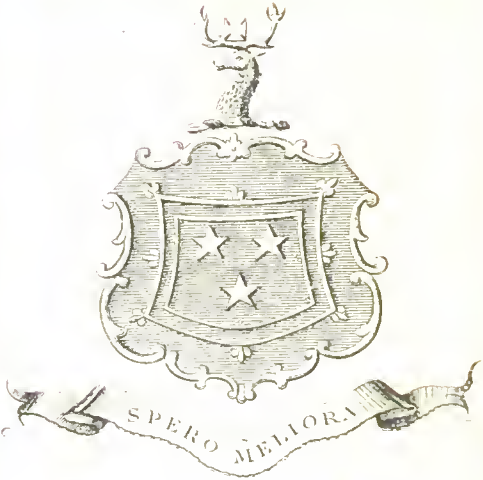
Insects:

Foes and Friends.

W. Egmont Kirby, M.D.



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BY

W. EGMONT KIRBY, M.D.,

WITH PREFACE BY

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PREFACE.

Insects are of comparatively small size, but there is a vast number of different kinds, and they are extremely prolific, so that many species exist in enormous numbers. A large proportion are vegetable feeders, and though there are many insects which can only feed on one or two allied plants, others are less particular about their food, and some will eat almost any plant.

The ravages of locusts have forced themselves on the attention of mankind from the earliest ages. These are different species of large grasshoppers (usually measuring from two to six inches across the wings), which sometimes multiply to such an extent as to migrate in flocks several miles in extent, darkening the air and devouring every green thing, leaving famine and pestilence in their train. The most destructive species are natives of Africa, Southern Asia, and the west of North America. Southern and Eastern Europe have suffered considerably at times; but locusts do not breed in Central Europe, where the climate is too cold for them; and in Britain, they only appear singly, as rare and casual visitors.

Some years ago, the potato-fields of North America were ravaged by the Colorado Potato Beetle to such an extent that all Europe was alarmed, and special precautions were taken to prevent its introduction, fortunately with success, for though the pest made its appearance in Europe once or twice, sometimes in very unlikely localities, it was promptly and effectually extirpated.

In France, the vine industry has been almost destroyed for many years past, over large districts, by the *Phylloxera*, an insect said to have been originally introduced from America. An account of this insect will be found in the present work.

In all these cases, the insects are destructive to plants, both as larvæ and as perfect insects; but in the majority of cases, insects are only injurious in the larval state; and although there are comparatively few insects which are so extensively destructive as those just noticed, yet there are many which materially reduce our crops, without entirely destroying them, and which are frequently too small, or too insidious in their attacks to be readily detected by any but a trained observer.

Most plants nourish several species of insects, and some, such as the oak tree, which seems to be a special favourite with them, is liable to the attacks of hundreds, if not thousands, of different species, large and small, and the inordinate multiplication of any one of these, resulting from some favourable combination of circumstances, may be enough to cause widespread injury to the plant on which it feeds. Nor can we always tell what insect may multiply sufficiently to be injurious. Sometimes a species which feeds on wild plants will begin to attack cultivated plants, and cause great destruction, as in the case of the Colorado Potato-Beetle. Sometimes an insect which is very destructive in one country may become extremely rare or extinct in another, without any apparent reason, as in the case of the Black-veined White Butterfly, and the Gipsy Moth, which are very destructive on the Continent, but are almost extinct in England. The numbers of some species, and the amount of harm done by them, is almost the same from year to year in some species, while others only multiply sufficiently to become really injurious at intervals, and in many cases long intervals.

The amount of mischief caused to farmers and gardeners in Britain, however, is much less than that to which they are exposed in many parts of the Continents of Europe and North America. Our damp, unsettled climate is peculiarly unfavourable to insect life, and our insular position also accounts for our insect-fauna being much poorer in species, as well as less numerous in individuals, than the neighbouring parts of Europe. Many species of insects, too, are much reduced in numbers by the operation of the Wild Birds' Protection Act, for most of the birds which fall under its operation are more or less exclusively insect-eaters, and I think it probable that the disappearance of the Black-veined White Butterfly from Britain is due chiefly to this cause.

Nevertheless, a large amount of damage is caused annually to our field and garden produce by the ravages of insects, and therefore it has been thought that an English adaptation of the present little book, which has had a large sale in Germany, would be useful as an introduction to the study of Practical Entomology. It does not pretend to be anything like an exhaustive work on the subject, but a considerable number of the more interesting and typical pests of the farm and garden are figured and described: and it will be a good exercise in Entomology for beginners to go into the fields or garden, and search for the insects themselves. Those who feel inclined to pursue the subject further, will find Miss Ormerod's "Manual of Injurious Insects" and Curtis' "Farm Insects" very useful and instructive.

Some of the species figured and described in this book are too rare with us to be likely to become injurious insects at present; but this did not seem to be a sufficient reason for excluding them.

The letterpress has been translated and adapted by Dr. W. Egmont Kirby, who is already favourably known to the Entomological world as a writer on popular Entomology.

W. F. KIRBY, F.L.S., F.E.S., &c.

Chiswick.

INTRODUCTION.

Insects are the most highly developed class of the Invertebrates, or animals without an internal skeleton. It is only necessary to look at the form of the wings and the beautiful colours of many butterflies, the wonderful adaptation of the body in bees for visiting flowers, the artistic construction of the nests of bees and ants, together with their gregarious mode of life, to perceive that they are entitled to this position. Insects are distinguished from the classes most nearly allied to them, namely, the spiders, crabs, and centipedes, by the distinct division of their bodies into head, thorax, and abdomen, in addition to which they have only three pairs of legs in the perfect state, one on each segment of the thorax, whereas the other classes mentioned have a larger number of legs. Most insects have wings, which are attached to the last two thoracic segments; of these there are either one or two pairs, and many insects are scarcely inferior to birds in their power of flight.

Insects are particularly interesting as regards their transformations. The cockchafer, for instance, lays eggs (*Pl.* 1, *fig. a*), from which are hatched larvæ (*fig. b*), which are creatures quite unlike the perfect insect. The larva lives from two to three and a half years underground, on the roots of plants, and then changes into a motionless pupa (*c*), from which, at last, the fully developed beetle emerges (*d*, *e*), which flies about in the air and lives upon the leaves of trees. The Cabbage White and other butterflies also pass through very different stages of development, involving great differences both of appearance and habits, but the transformations of some other insects are simpler, as in the mole-cricket (*Pl.* 2) and others.

Is it then surprising that such series of changes have always attracted the attention not only of the learned, but also of general observers? Add to this the variety of form and of external appearance, and the mode of life of the perfect insects. What a contrast there is between the *Coccidæ* (*Pl.* 31, *fig.* 3), which rest motionless with their probosces inserted in the leaves or bark of a tree, and the active bees, which wander from flower to flower, collecting honey and pollen for their helpless brood! Compare again the large stag-beetle with its formidable antlers and its powerful coat of mail, with the delicate little gnat, which is hardly noticed, in spite of its tiny hum, till it pierces the skin with its sharp proboscis.

Naturalists have attempted to classify the manifold forms of insects in various ways. Those represented on our plates may be systematically placed in the following Orders:

I. *Hymenoptera.* Pl. 4, fig. 2; Pl. 27, figs. 2, 3, 4, Pl. 29, fig. 1.

II. *Coleoptera.* Pl. 1; Pl. 3, fig. 1; Pl. 4, fig. 1; Pl. 9, fig. 2; Pl. 10; Pl. 11; Pl. 12, figs. 1, 4, 5; Pl. 13, figs. 1, 2; Pl. 14; Pl. 16, fig. 1; Pl. 25, figs. 2, 6, 7; Pl. 26; Pl. 27, fig 1; Pl. 28, fig. 1; Pl. 31, figs. 1, 2.

III *Lepidoptera.* Pl. 3, fig. 2; Pl. 6; Pl. 7; Pl. 8; Pl. 9, fig. 1; Pl. 12, fig. 2; Pl. 13, fig. 3; Pl. 15; Pl. 17; Pl. 18; Pl. 19; Pl. 20: Pl. 21; Pl. 22; Pl. 23; Pl. 24; Pl. 28, figs. 2, 3; Pl. 29, figs. 2, 3; Pl. 32.

IV. *Diptera.* Pl, 4, fig. 3; Pl. 5; Pl. 25, fig. 3; Pl. 28, fig. 4.

V. *Neuroptera.* Pl. 12, fig. 3; Pl. 25, fig. 4.

VI. *Orthoptera.* Pl. 2.

VII. *Hemiptera.* Pl. 16, figs. 2, 3; Pl. 25, figs. 1, 5; Pl. 30; Pl. 31, fig. 3.

The number of known species of insects is estimated at about 300,000, and though our own insects are only a small fraction of the whole, yet an attempt to give a general Natural History of British Insects (estimated at upwards of 12,000 species), even in the briefest form, would be quite impossible within the limits of a small volume.

A large proportion of insects may be regarded as dangerous enemies to plants, and it is thus to the interest of gardeners and farmers to learn to recognize those which are injurious, in order that they may be able to destroy them, and also to know what insects are beneficial, so that these may not be indiscriminately destroyed as the authors of the damage which they are really engaged in minimising.

In the present little work, we have confined ourselves to detailing the history of a selection of typical examples of those insects, which most frequently cause serious injury to cultivated plants in Britain and the neighbouring parts of Europe. The means of destroying them are given, when possible, under the separate insects, but a few general remarks on the protection of fruit trees against their ravages may not be out of place here.

Experience shews that most destructive insects are found upon sickly or decayed trees, and so good manuring and similar means of promoting robust growth, combined with appropriate remedies, will contribute much to counteract insect depredations. All loose bark, moss, and lichens, so prolific a wintering place for all kinds of vermin, should be entirely removed every autumn, carefully collected, and burnt. The trunks of trees may be painted with lime-water, made from fresh lime, or an admixture of cow-dung and clay may be used, as this also forms a protective paint. As many insects hybernate in the ground, and others pupate below the surface, the ground about the trees should be well dug up, in order to destroy them. The use of bands of lime will be discussed under the winter moth. Similar traps can be made to catch insects and caterpillars; some hay, or fine wood shavings, is pushed into a thick roll of paper, and this is tied round the trees in July or August. In this welcome retreat many injurious insects assemble towards winter, and can easily be destroyed by burning the traps, together with their contents, in January or February. Strips of cloth may also be tied round the trunks, and are especially useful in attracting small caterpillars, such as those of the codling moth.

All these preventive means are easier of application and more effective than destroying the little pests at the time when they are committing their depredations.

ERRATA.

Plate 14 fig. 1, for *Bark-Beetle* read *Apple Bark Beetle.*

Plate 16, fig 3, for *Apple Aphis* read *Apple Coccus.*

INJURIOUS INSECTS.

I.—Insects Injurious to Cultivated Plants and Trees.

A.—INSECTS INJURIOUS TO ROOTS.*

The Cockchafer (*Melolontha vulgaris*, Fabr.)

Plate 1

This handsome beetle appears about May, and is a common insect in England. Both the beetle itself and its larva, the White Grub, are well known, for whilst the beetle sometimes appears in large numbers and strips the leaves from various trees, the larvæ attack, in still greater numbers, the subterranean portions of the plants in gardens, fields, and woods, so that neither can well escape the notice of the most superficial observer. Cockchafers often appear in considerable numbers about every three or four years. They pair on the warm spring evenings during flight, and a few days afterwards, the female (which is distinguished by the smaller six-lamellated antennæ from the male with his larger seven-lamellated antennæ), burrows into the ground to the depth of from four to six inches with the help of the broad spiny tibiæ of the front legs and the long pointed horny end of the abdomen. Here are laid from twenty to forty dull white eggs, of the size of peppercorns, near together. They are generally found in loose vegetable mould. The larvæ emerge from the eggs after from four to six weeks. At first they live on the dung of animals or on decaying vegetable substances, but after a time they commence to feed on the roots of live plants, and thus become injurious. There are always plenty of these larvæ to be met with in various stages, though they are much more destructive in some years than others. In the third or fourth summer, after having moulted several times, the larva attains maturity. It now works its way for three feet or more into the ground, and here forms an oval smooth-walled cell, casts off the larval skin for the last time, and becomes a pupa. This already exhibits all the parts of the beetle, covered with a fine yellowish membrane. In the course of the autumn, not later than November, the pupa-skin is also shed, and the cockchafer is completely formed. Pale and soft at first, it remains in the pupal cell until it has completely developed, and its chitinous armour has hardened and become coloured. It then works its way slowly upwards, but seldom leaves the ground until spring. When the May-sun warms the earth the beetles emerge from round holes, and the evening air is filled with their humming and whirring.

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* We have placed those insects which feed upon different parts of plants in the larval and perfect state in that group in which they do the greatest damage; thus the cockchafer must be classed with the insects which are destructive to roots.

As soon as the cockchafers appear in large numbers it is necessary to take energetic measures against them. In the early morning, when the beetles hang from the leaves in a half torpid state, they should be shaken down from the trees upon outspread cloths and swept into bags. They may be killed quickly by plunging the bags into boiling water. The dead beetles may be used as manure if mixed with slaked lime and earth moistened with water or liquid manure, or the dried beetles will form a useful addition to the ordinary food for pigs and poultry. To show what may be done towards reducing the numbers of this pest when it is unusually abundant, we may mention that according to official reports, in the spring of 1868, 30,000 hundredweight of cockchafers were collected in the province of Saxony, which, reckoning about 500 beetles to the pound, means the destruction of some 1,500 millions of cockchafers! Such wholesale destruction of the grubs is scarcely possible, yet the farmer should not fail to collect and kill any larvæ which may be met with when turning up the soil. If it be desired to destroy the grubs over a small area, several holes should be dug, about a foot deep and broad, filled with fermenting dung and covered over with soil. After some time the grubs will have collected at these places. It is then only necessary to spread out the dung in the midday sun, which soon kills the grubs.

It is very desirable that animals which feed on cockchafers and their grubs should be protected as much as possible. Many insect-feeding birds, such as the starling, devour them as they emerge from the ground; and during the evening flights of the cockchafers, they are chased by owls, goatsuckers, and bats. The omnivorous mole looks for the white grubs in the ground, and should therefore not be destroyed, whilst the ploughman is followed by ravens, rooks and jackdaws, and near the sea and on rivers also by sea-gulls, which pick up the grubs, etc., as they are ploughed up.

The Mole-Cricket (*Gryllotalpa vulgaris*, Linn.)

Plate 2.

This is a strange-looking insect, which cannot be mistaken for anything else. At the very first glance this creature, with the broad shovel-shaped and toothed tibiæ of its front legs, and its powerfully developed muscular prothorax, reminds one of a mole. On the other hand we notice that the hind legs are not specially adapted for jumping as they are in most crickets. Moreover the fore-wings are only slightly developed, and scarcely cover the front half of the abdomen; but the front margins of the folded hind wings project beyond the end of the abdomen, where they curve downwards between the curious abdominal bristles which are common to all crickets. The powerful jaws show that the creature is a voracious feeder, and the more so because nearly the whole life of the mole-cricket is spent underground, so that the destruction of this pest is very difficult to effect.

The mole-cricket digs passages near the surface where the soil is not too heavy, and here obtains its nourishment, which consists of the roots of grass, vegetables, and trees, as well as small animals. Its ravages are most noticeable in the neighbourhood of its nest. The mole-crickets pair in June or July, and about this time and even earlier the males produce a slight chirping noise in the evenings; and they may sometimes be seen flying singly with a heavy flight. After pairing, the female sets to work to make a nest, and digs a spirally-descending passage, at the end of which, at the depth of about four inches, it forms a smooth-walled cavity, about the size of a hen's egg. This cavity is intended to receive the eggs, which are about the size of turnip-seeds, and are laid at intervals to the number of about three hundred. From the breeding chamber the female digs several holes downwards to regulate the dampness of the air in the nest, and others obliquely upwards to the surface, and these latter she uses for retreat in case of danger. It is three weeks before the young ones emerge from the eggs, and during this time the mother remains in the vicinity of the nest, to watch over the eggs, often returning to the roomy chamber. The nest is generally placed in localities where there is not too high a growth of vegetation, especially in freshly manured fields, where the withering of the plants in the neighbourhood, and the slightly upturned earth at the mouths of the burrows indicate the spots. By digging carefully, it is possible to lift out the whole nest as a lump of earth about the size of the fist, and by exploring the galleries with the finger also to secure the female. The eggs may either be thrown on hard ground in the sun or into water, as they are destroyed both by dryness and wet. The larvæ moult three times before winter, and soon separate. They hibernate more deeply in the ground, and moult twice more in the spring, when the wings become developed, so that towards the end of May there are sexually mature individuals.

From what has been said, it will be seen that the most effective method is to look for and dig up the nests (taking care to get them out whole, lest any eggs be left in the ground). At the same time the female must be caught and killed, in case she may not have laid all her eggs.

In the garden the mole-crickets may also be caught in flower-pots set in their burrows, so that the bottom of the burrow is above the rim of the pot. Of course the hole in the bottom of the pot must be closed. The burrows are most easily seen after a slight shower, or in the morning after a heavy fall of dew, as the little mounds of earth dry more quickly, and may be distinguished from the damp soil around.

Mole-crickets may also be attracted in the month of September by digging pits in places in which they are known to be numerous, and filling these with horse dung, in the manner already recommended in the case of white grubs (cockchafer larvæ).

The Striped Click-Beetle (*Agriotes lineatus*, Linn.)

Plate 3, *fig.* 1.

If one of these beetles be placed on its back upon a smooth flat surface, it will for a time try by means of its short legs to turn itself over, but without success. It then draws its legs up close to the body as though it were dead, curves its back, and sets the points of a projection with which it is provided behind the prothorax against the edge of a conspicuous groove in the mesothorax. Suddenly the point slides obliquely into the groove with a click, and this jerks the creature up, which will in falling gain its legs, if not at the first trial, at any rate at the second or third attempt. This peculiarity has given the name of click-beetles to a whole family of these insects.

Whilst the beetles themselves are harmless enough, spending most of their time on flowers, the larvæ, which are called wire-worms, on account of their long, narrow shape and tough skin, live in the ground, and are extremely destructive. They bore their way into potato-tubers, beet-root, bulbs, etc., and feed upon the roots of all sorts of plants, and are especially injurious to young plants. They are, however, also found in rotten wood and in tan, etc. As the development of the larvæ continues for several years (up to five years) there are of course several generations of wire-worms in the ground at the same time. In June the delicate white pupæ of different species, which already exhibit the form of the perfect beetles, are to be found in the ground. The pupa-state only lasts for a few weeks.

The most injurious of this family is perhaps, in spite of its small size, the Striped Click-Beetle, which is distinguished by four pale longitudinal lines on the yellowish brown punctate-striate wing-cases. The ravages of the larvæ, which are only about three-quarters of an inch long, are most noticeable on young corn in April and May on the summer crop, and in September and October on the winter sowing. They gnaw the plants close above the roots, so that they turn black at this point, droop, and generally die.

As a preventative against the wire-worms, shallow drilling may be useful, as the young plants, at this stage, have such small roots that they are not likely to be injured by the drill. The wire-worms may be reduced in numbers by frequently turning over the soil, as in this way many are immediately killed, whilst others will be eaten by birds. In addition it is useful to collect the larvæ when working in fields or gardens. When the wire-worms are especially abundant, they may be found and destroyed in corn-fields, the withered plants showing their presence in the ground. According to one account, a boy collected eight hundred wire-worms in the course of a single afternoon.

The Ghost Moth (*Hepialus humuli*, Linn.)

Plate 3, fig. 2.

The Ghost Moth is one of the root-borers. The larva lives underground, boring into the succulent roots, tubers, and bulbs of various garden and field-plants, upon which it lives. Its hidden existence corresponds with its pale yellowish white colour. Only the head, the horny cervical plate, and two small horny plates on each of the two segments behind the head are brown, whilst the spiracles (or air holes), and some small bristly warts on the upper surface are black. The caterpillar lines its burrows in the plants as well as in the ground with a fine web, and enters the pupa-state in one of these passages in April. The pupa, like that of the goat moth, is provided with a circle of spines on the segments. By means of these it pushes itself out of its concealment in June, and the moth emerges. The moth has very short antennæ, and wings which do not quite meet when in flight. The wings are silky white above in the male, and dark grey beneath; but in the female they are pale ochre-yellow, with dull red stripes and spots, and darker beneath. The moths flutter heavily about at night at a moderate height above the turf, and during its flight the female scatters a large number of little white eggs, which very soon turn black, so that they look like grains of gunpowder. The young larvæ appear in August.

In the fields, where the larvæ congregate in the largest numbers, their ravages, which are least observed on grass, are not very apparent, but are more conspicuous in kitchen gardens on beet, carrot, lettuce, etc., and especially on the thick roots of the hop. It is naturally difficult to destroy the pest without digging up the whole plant attacked, but whenever possible, as in turning up the soil, the caterpillars should be collected and killed.

The larvæ of the Daddy Long-legs, or crane fly (*Tipula oleracea*, Linn.) are also very destructive, especially to the roots of grass and corn.

B.—INSECTS INJURIOUS TO THE STEMS OF PLANTS.

The Turnip Gall Weevil (*Ceutorrhynchus sulcicollis*, Gyll.)

Plate 4, *fig.* 1.

At the roots or on the lower part of the stalk of various kinds of the cabbage tribe may often be observed gall-like excrescences, each of which contains a yellowish white, footless larva, with a brownish head, lying in a cavity. This excavation is constantly enlarged by the gnawing of the larva, and dung and refuse collect in it. Finally the larva passes out through a round hole which it has made and pupates in the ground. About four weeks afterwards, a small compressed black beetle emerges from the pupa, scarcely one-eighth of an inch in length. This weevil may be known by the strongly marked central groove on the deeply punctured thoracic segments, the prominently ridged wing-cases, the sparse covering of the upper surface, and the thicker covering beneath of fine grey scales, as well as the proboscis curved backwards under the thorax.

The beetle prefers to feed on the flowers of cabbage and other *Cruciferæ.* After pairing, the female descends to the lower part of the stem of young plants, and there deposits her eggs. The plants which are attacked are stunted in their growth by the formation of the gall-like excrescences, and the gnawing of the larvæ, and the injury caused by the beetle when it appears in large numbers is not inconsiderable, even if they only occasionally destroy a plant.

To take measures against this pest is however all the more difficult because the beetles appear throughout the greater part of the spring and summer, and consequently the time for development varies. We would, however, recommend the following means of diminishing their numbers:—

1. To shake the beetles off the flowers into a wet beetle-net held under them.

2. To dry and burn the stalks of different kinds of winter cabbages very early in the spring, when the galls are still closed.

The Corn Saw-Fly (*Cephus pygmæus*, Linn.)

Plate 4, fig 2.

If the farmer notices, among corn, stalks with whitish discoloured ears, he should examine them to see whether it is not caused by the attacks of the corn saw-fly. If this is the case he will find in the stalk, which must be split down from above for the purpose, a whitish, fleshy larva with strongly constricted segments. The thickened front portion is directed downwards, and the larva eats through the stalk from above down, boring through one knot after another, and finally spinning itself up in the lowest part of the stalk for the winter. If the corn is now cut, the larva generally remains behind in the stubble and hibernates there, but does not pupate till the spring, when it remains in the pupa for about fourteen days, the perfect insect usually emerging in May as a little saw-fly about a quarter of an inch long, whose slender body reminds one of the ichneumons, but which is really a saw-fly. It is readily distinguished, however, as a saw-fly by the broad stalked head with the antennæ slightly thickened towards the tips, and by the black, yellow-belted abdomen. These saw-flies are to be seen in May and June, sitting lazily upon the ears and stalks or feeding upon the honey of field-flowers. The female has a pointed ovipositor, which extends a little beyond the extremity of the abdomen. By means of this it inserts its eggs to the number of 12 or 15 into the lower part of the upper knots of the stalk, but only laying one egg in each. With the exception of this scar the stalk shows no injury externally, and it is only the stunted ear which indicates the unwelcome parasite.

The stalks which are attacked are, of course, irretrievably destroyed, but it is possible to take precautions against the rapid increase of the pest. The closer to the ground the corn is cut the fewer larvæ will remain behind in the stubble, and the fewer will consequently attain maturity. Pulling out and burning of the stubble, or ploughing it deeply into the ground, will also destroy many of these enemies.

The Frit Fly (*Oscinis frit*, Linn.)

Plate 4, fig. 3.

In many localities, in May, the following symptoms of disease may be found on oats, barley, wheat, etc. The leaves, beginning with the outer ones, turn yellow and gradually wither, and if the heart of the plant is finally attacked, plants which are quite young perish. In the case of older plants which are already in the stalk, the stalk itself remains still green, and the plants sprout afresh from the root, but are always much retarded in growth. On examining such plants more closely we shall find at the base of the leaves cylindrical whitish maggots, from one-twelfth to one-sixth of an inch long, which have attacked the leaves at their base. We may perhaps also find under the outermost leaf-sheaths or those next to them, the pupa, resembling a small shining light brown barrel. If this be brought home uninjured and kept in a closed box, one may, within a week, make the acquaintance of the insect, which has now passed through its young stages. It is a slender fly, about a tenth of an inch in length, shining black, with a metallic lustre, with only the ventral surface pale brown, and the feet yellowish. The name Frit is derived from the Swedish, and means light corn, the larvæ having been first met with in Sweden in half ripe grains of corn, which had been crippled by them.

The flies, which appear in June, rarely find corn suitable for the nourishment of their progeny, as it is then too far advanced for their purpose, and they lay their eggs on meadow-grass. The flies which emerge from these in September lay their eggs again on winter wheat, but without causing much injury to the crop. The pupæ hibernate in the winter wheat, and the flies emerge at the end of April, their progeny again causing injury to the summer crop.

In order to protect the summer crop from the ravages of these pests, which always originate from the winter crop, it is advisable to sow the fields between the winter and summer crops with clover, etc.

The Ribbon-footed Corn-Fly or Green Eye (*Chlorops tæniopus*, Meig.)

Plate 5, *fig.* 1.

A disease which occurs on wheat, rye, and barley, which is known as *gout*, is caused by a fly. The ear either remains covered completely by the last leaf-sheath, or barely projects, and produces only stunted grains. If the husk is opened there will be seen beneath it on the short thickened stalk a brown furrow, from two to four inches long, running down from the ear, and cutting deeper into the stalk towards the lower extremity. It is here that the cause of this malformation may be found—a yellowish white maggot about one-fifth of an inch in length. Later (in August or September) the fly appears, which lays its eggs on grass (*Holcus*, *Poa*, *etc.*), and the larvæ are subsequently found attacking the stalk as above described. If the fly meets with the young winter crop, it will attack this in preference, and lay its eggs on the leaves. The larvæ bore down as far as the base of the root, and spend the winter there, causing, in the spring, a bulb-like thickening of the shoot in which they live, and finally the death of the latter. The plant, however, sprouts out afresh, and consequently the injury is not so serious as in the summer. The flies from this winter brood appear about the middle of May. They are shining yellow, and about one-eighth of an inch in length, with black antennæ. On the thorax are three shining black, longitudinal lines, and on the abdomen four ill-defined, dark brown, transverse bands, the first of which terminates in two dark dots. The legs are yellow, the front tarsi being, however, black, with a yellow ring in the middle in the male, hence the name "ribbon-footed." The name "green-eye" applies not to this species only, but also to several others which are closely allied.

The ribbon-footed corn-fly is most destructive to barley.

Professor Nowicki, as a result of his observations, recommends the following remedies against this pest :

(1). Early sowing in good ground.

(2). Sowing the strongest and hardiest varieties of wheat instead of the less hardy varieties.

(3). Limiting the crop to winter wheat when the pest is most serious, and dispensing with the summer crop, which would be almost completely destroyed.

(4). Good drainage of the field.

(5). Spreading manure evenly over the furrows, so that the plants may everywhere have as strong a growth as possible.

(6). Cutting off the extremities of the ears with the twisted leaves, so that the ears may sprout again, is said to have been useful where the plants were only sporadically attacked.

Dr. G. Röring suggests: 1. That the sowing of the winter crops should be deferred till the middle of September, as the flies have for the most part already laid their eggs by this time. 2. That a narrow strip of rye should be sown in the infected field, and that it should be deeply ploughed in after the flies have laid their eggs, after which the field may be treated as usual. If a field should be very much attacked, the neighbouring fields should not be used for corn. 3. The summer plants attacked should have the stalks cut off below the highest knot, and this should be burnt. This is especially desirable on the edges of fields, where the destruction is generally most considerable.

The Hessian Fly (*Cecidomyia destructor*, Say).

Plate 5, *fig.* 2.

If a wheat or rye-field is seen towards the end of June with a large number of the stalks bent downwards as if it had been beaten down by a hail-storm, or as if a drove of cattle had passed through it, it is most probably caused by a number of the larvæ of the above-mentioned insects. The maggot is only one-eighth of an inch long, and is yellowish white, with translucent edges. It is usually most numerous above the lowest knot in the stem, or the lowest but one, inside the leaf-sheath, and its sucking causes the part of the stem above it to shrink and wither. The ears are either not developed at all, or under the most favourable circumstances only stunted grains ripen. The pupa of this fly, as in the case of the foregoing species of flies, is enclosed in the shrunken skin of the larva, which becomes brown, and is concealed under the leaf-sheath. It differs from the barrel-like pupæ of the typical *Muscidæ* by its smaller size (one-twelfth of an inch) and the downward curved hook at its anterior extremity. The perfect insect is a small midge, only one-eighth of an inch long, with the ground-colour velvety black, the abdomen only being blood-red, marked with black squares. The principal time of appearance of the midge is in September, and the winter brood is provided for in the same way as in the case of the ribbon-footed corn-fly. The larvæ of this brood are full-grown towards winter, but they do not pupate till April or May, and shortly afterwards the fly appears for the first time for that year, and causes the above-mentioned injuries. As a corn-destroyer the insect is found on both sides of the Atlantic. In North America its ravages were first noticed at the time of the War of Independence, and it was supposed to have been imported among the baggage of the Hessian troops in the English service, whence the name.

It has frequently proved very destructive in various parts of Europe, but has only been recognized as a British insect within the last few years, though there is reason to believe that it has inhabited this country for a much longer period, even if it is not actually an indigenous British species. However, it is not known to have committed serious ravages in England at present.

Precautions to be observed:

(1.) Sowing the winter crop in October, after the flies have disappeared for the season; and not sooner.

(2.) To plough the infested stubble deeply into the ground, or to tear it out and burn it. The after-growth of barley, springing up from dropped grain, which forms a good opportunity to the flies swarming in the autumn to lay their eggs upon, should also be ploughed in.

Besides the above-mentioned flies and midges, there are many other two-winged flies which are injurious to corn. Of these we will only mention two, *Epidosis cerealis*, Saut., which is especially destructive to barley, etc., and the wheat midge (*Diplosis tritici*, Kirby), the larvæ of which is found infesting the young grains.

C.—INSECTS LIVING ON LEAVES.

The Large Cabbage White Butterfly (*Pieris brassicæ*, Linn.)

Plate 6.

The large white butterfly may be met with wherever cabbage and turnip fields, or mustard and other *Cruciferæ* are found, and also in flower gardens, on stocks, Indian cress, etc.; and it is often very destructive. Who has not seen cabbage fields on which no leaf is left, but only the bare stumps and the largest leaf-stalks remain, everything else having been devoured by the caterpillars? Hunger then drives them to the nearest fields, sometimes in such dense crowds that, on crossing a line of railway, they have been known to stop the trains, the rails being greased by their crushed bodies. Such vast numbers of caterpillars, however, are only found late in the summer, from the second brood. The first brood, which springs from the hibernated pupæ, is scarcely noticed, firstly on account of its numbers being much smaller, and secondly because they are then more attached to wild plants on account of cabbages being planted out later in the year. The chief time of flight of the butterfly is in July and August, when extensive migrations may be observed, and at such times they have been noticed even to cross the Straits of Dover. What is then the explanation of this great abundance, and of the devastation which the larvæ of the white butterfly especially cause? The female, which may be known by the two black spots on the upper surface of the fore-wings, lays its pear-shaped, yellow eggs—often numbering upwards of a hundred—on end, in rows on the leaves of the plants. When the larvæ emerge from the eggs, they remain together permanently, and develop an extraordinary appetite. They daily eat many times their own weight of the leaf. There is only a pause of two days at the times of moulting. Then they all rest stretched side by side on the under surface of the leaf, attached by a few spun threads. But scarcely is the old skin cast off, and the mouth parts sufficiently hardened, than they recommence feeding with renewed vigour. One can often gauge the progress of a caterpillar on a cabbage by observing three cast-off skins in three different situations on the plant. After the third moult the larvæ disperse, and each feeds in future by itself. until ready to pass into the pupa-state. This seldom occurs on the food-plant. but usually on walls, planks, posts, etc. The larvæ often wander for long distances in search of such places, going always straight on, up houses to the highest story, and if a window lies in their path which their feet cannot grasp, they laboriously spin a ladder to surmount the obstacle. The pupa rests upright on exposed surfaces, or under eaves or cornices, and is generally fixed by the hinder end to a thin button of silk, and is supported by a strong band in the middle.

It is remarkable that in spite of the large number of caterpillars in the autumn so few butterflies appear in the spring; yet a careful observer cannot fail to perceive the reason. The larvæ, if not killed by frost at night, usually reach their maturity apparently uninjured. Birds seem to ignore them entirely, probably because of the stinking green fluid which they emit when touched, but in reality a large proportion of caterpillars which enter the pupa-state are already inhabited by the larvæ of various ichneumon flies, etc., most commonly by the minute *Microgaster glomeratus.* These larvæ generally reach maturity about the same time as the caterpillars, when they emerge from the skin of the latter, and the caterpillar dies. The pupæ of the cabbage white butterfly are also attacked by ichneumons; many also fall a prey to tit-mice and other small birds, and consequently their numbers are immensely reduced in autumn and winter.

The precautions to be observed in the middle of the summer are limited to the destruction of the eggs, and treading on the young larvæ whilst they are gregarious; but constant searching for them is necessary. Where many pupæ are found together, as under the tiles of roofs, it would also be worth while to destroy them, but all dark-coloured immovable pupæ should be preserved; as they contain parasites, and the yellow cocoons of *Microgaster* should also be preserved, when met with.

USEFUL PARASITES:

Microgaster glomeratus, Linn.

Who has not seen on leaves, on walls, or even on the ceiling, little masses of yellow cocoons, beneath or beside a dying cabbage white caterpillar? These are called caterpillar's eggs by the ignorant. Anyone who wishes to know what these cocoons indicate need only put them in a box, and after a few weeks look at them. Out of each cocoon a small lid has then been gnawed, and a swarm of little black wasp-like creatures, with a short abdomen (whence the name *micro-gaster*) tries to escape. If the observer now finds, while clearing his cabbage garden of the greedy caterpillars, that nearly half of these destructive creatures, when trodden upon, are full of white maggots, the whole matter will become clear. Should he happen to notice one of these little black ichneumons ovipositing, its whole life history will lie before him.

The genus *Microgaster* belongs to the family *Braconidæ*, which is closely allied to the true ichneumon-flies, and includes small species, whose larvæ live gregariously in the insect attacked.

One of the smallest of the small is *Aphidius varius*, Nees, which lays its eggs in *Aphides*. It is easy to rear if a number of the shining dead *Aphides*, found everywhere on green leaves, be collected in a well-closed box.

Pteromalus puparum, Linn.

Whereas *Microgaster* attacks the cabbage caterpillars, this insect pierces the pupæ as soon as they have shed the larval skin, and are still soft. They soon become immovable and often discoloured, and in the spring a number of fully formed little insects break through one or more minute holes. They are scarcely an eighth of an inch long, and often come forth in hundreds from a single pupa.

The Small Cabbage White Butterfly (*Pieris rapæ*, Linn.)

Plate 7, *fig.* 1.

Apart from its smaller size, this species closely resembles the larger white, but the black at the tips of the fore-wings does not extend so far along the hind margins. The larva, however, is green and downy, with a slender yellow line on the back, and a stripe of the same colour on the sides, which passes over the black-bordered spiracles.

The Green-veined White Butterfly (*Pieris napi*, Linn.)

Plate 7, fig 2.

This is of the same size as the preceding species. The spots and markings are nearly the same, but the nervures of the wings are dusted with blackish above and greenish beneath. The caterpillar of this species is also green, but the yellow line on the back is absent or indistinct. The spiracles are bordered with yellow, and under them is often another yellowish lateral line. The back is dotted with black, and the belly with whitish.

The small white and the green-veined white both lay their eggs singly on the under surface of cabbage, turnip, and rape leaves, etc. Their caterpillars consequently are not gregarious. They are scarcely distinguishable from the leaf on account of their colour, especially when they lie stretched out upon a midrib of a leaf. In other respects the three white cabbage butterflies agree almost entirely in their habits.

The destruction of the two last-named species is much more difficult than that of the large white, as shown by what has been said above; however, in collecting the caterpillars of the last, many of the smaller species may be found and destroyed. What has been said about the pupæ of the large white is also applicable to these.

The Turnip Moth (*Agrotis segetum*, Schiff.)

Plate 8.

The winter crop of wheat has scarcely began to recover from the injurious effects of frost and melted snow, when it is liable to injury from another cause. The tender young shoots in the centre of the plants are eaten out without any destroyer being visible. Particles of excrement, however, will show us that the injury is caused by caterpillars: and on more careful examination we shall find sometimes on the ground under leaves, and at other times hidden in a hole, thick cylindrical shining caterpillars of a clay colour or greenish grey, with scattered bristles. They lie in the daytime curled up, resting after their nightly labours. These are the caterpillars of various moths, which are not easy to distinguish. Of nearly 50 British species belonging to the restricted Family *Noctuidæ*, the Turnip Moth, whose caterpillar is distinguished by its strong lustre, is one of the commonest and most destructive. The caterpillar hibernates in the ground when nearly full grown, and commits ravages in autumn and spring by attacking young corn, bulbous plants, and various kinds of vegetables, and changes about the middle of May in a hole in the ground into a reddish brown chrysalis, with a pointed extremity. Four weeks later the dull-coloured moth emerges, which is distinguished at once as the Turnip Moth by resting in the daytime on the ground, with the wings vertical and not sloping. When disturbed, it runs away shaking its wings, then flies hither and thither abruptly, but soon disappears suddenly by dropping to the ground. In consequence of these peculiarities both the caterpillar and moth are seldom seen, although their ravages are plainly visible.

One of the most conspicuous of the *Noctuidæ*, on account of its size and colour, is the Yellow Underwing (*Triphæna pronuba*, Linn.) so called because of its yellow hind-wings bordered with black, which, when the creature is at rest, are hidden beneath the mottled grey and reddish brown fore-wings. The caterpillar is also readily distinguished by the two thick black dorsal lines, commencing upon the fifth segment, and interrupted upon each segment. It is often destructive to cabbage, lettuce, carrots, auriculas, and occasionally to vines. The habits are nearly the same as those of the last species.

It is not easy to take precautions against the *Noctuidæ* to any great extent. During the cabbage and turnip season in the autumn, and when the ground is being prepared in the spring, many caterpillars will be found, and may be killed, as well as when the melting of the snow drives them out of their winter quarters. If a single bed is particularly injured, the caterpillars should be searched for at night with a lantern.

The caterpillars of the *Noctuidæ* are called "cut-worms" in America from their habit of eating through the roots of plants beneath the surface of the ground. Those of *Agrotis segetum* are often especially destructive to turnips, into which they eat, whence the popular name of the insect.

The Cabbage Moth (*Mamestra brassicæ*, Linn.)

Plate 9, *fig* 1.

The caterpillars of the cabbage moth are still more injurious to cabbages and cauliflowers than even those of the white butterflies, for whilst the latter live openly upon the leaves, the former frequently bore into the heart of the plant, fouling it with excrement, and often causing it to rot. The caterpillars, which vary much in colour, are, however, met with not only in cabbages, but also on lettuce, mangel-wurzel, dock, and a variety of other plants. The caterpillars are generally found in September and October. These cause the greatest injury. Their chrysalids hibernate in the ground, and the moths appear in May, June, or July, when they lay their yellowish green eggs singly on the leaves of plants. The moth is seldom seen by day, but lies hidden with its wings close to its body. A conspicuous W-shaped mark in the white sub-marginal line of the greyish brown fore-wings of the cabbage moth is common to the rest of the genus, but the moth is distinguished from the others by a curved spine at the extremity of the front tibiæ.

The caterpillars of this moth should be looked for on the cabbage heads in September, before they have eaten into them. They will usually be found hiding under the outer leaves.

USEFUL INSECTS.

The Gold Beetle (*Carabus auratus*, Linn.), Plate 9, fig. 2, is one of the handsomest of the ground beetles. Both the caterpillar and its larva are carnivorous, and destroy many small pests. This beetle is common in many parts of the continent, and has been met with occasionally in Britain, having probably been introduced with vegetables. The ground beetles are as a rule carnivorous, and are therefore to be classed as useful insects; but the Wheat Ground-beetle (Plate 11, fig. 1) is a notable exception.

The Striped Turnip-Beetle (*Haltica nemorum*, Linn.)

Plate 10, *fig.* 1.

The Cabbage Flea-Beetle (*Haltica oleracea*, Linn.)

Plate 10, *fig.* 2.

The Rape Flea-Beetle (*Psylliodes chrysocephalus*, Linn.)

Plate 10, *fig* 3

The flea-beetles are small insects with well-developed hind legs, having thickened femora, enabling them to leap. They are very destructive, especially to young plants, by riddling the leaves with holes, and they often completely destroy young seedlings which are just sprouting.

Of the numerous species, the three mentioned above are more especially destructive to cabbage and linseed. The three beetles are distinguished as follows. Striped flea-beetle, length, one-eighth of an inch, metallic black with a green lustre, and a sulphur-yellow, longitudinal stripe on each of the wing-cases. Cabbage flea-beetle, length, one-sixth of an inch, shining uniform green, or bluish green. Rape flea-beetle, length, one-sixth of an inch, shining blue-black, or greenish black, above. The head, at least in front, the base of the antennæ, and the legs. except the dark metallic hind femora. dull orange.

These beetles are met with in a succession of broods from spring to autumn. upon various cabbages, cress, and other cruciferous plants, both wild and cultivated.

Not unfrequently all the three species are found together in numbers. The larvæ of the second and third species live on cruciferous plants like the beetles, and those of the striped turnip beetle mine the leaves, which causes dirty white spots to appear upon them. Those of the rape-beetle bore in the stems and roots, and are consequently extremely destructive to the plants attacked. The cabbage beetle, on the other hand, does not lay its eggs on the plants which the beetle itself attacks, but on quite different plants, especially on various kinds of willow herb, on the leaves of which the dark brown bristly larvæ live exposed. The pupation of the six-legged larvæ takes place on the ground.

The destruction caused by the flea-beetles is greatest in sunny weather, and on dry, exposed beds and fields. It is advisable, therefore, to plant cabbages, etc., in damp, sheltered ground. By sowing cress as a border, the flea-beetles may be partially diverted from the cabbage plants, and they can then be brushed off with a damp net in the early morning or in cool weather. As a direct preventive it is recommended to dust the seedlings or young cabbages with finely powdered dried fowl's or pigeon's dung, mixed with wood ashes or fresh slaked lime. It has also been recommended to sprinkle the plants with an infusion of wormwood, made by throwing a handful of wormwood into a bucket of boiling water, and letting it stand for twelve hours to settle, which is said to make the food quite unpalatable to the insects. But both these methods have to be repeated after rain. To catch the beetles it is a good plan to bind a large bundle of twigs to the end of a pole, dip it in hot tar, and pass it over the plants in the warm sunshine: the active beetles jump up and are caught by the tar.

The flea-beetles are often so destructive to young turnip plants, that their attacks are more dreaded by farmers than those of almost any other insects.

The Asparagus Beetle (*Crioceris asparagi,* Linn.) *Plate* 10, *fig.* 4.

The Twelve-spotted Asparagus Beetle (*Crioceris duodecim-punctata*, Linn.)

Plate 10, *fig.* 5.

These two pretty little beetles, which measure about one-fifth of an inch in length, and are double brooded, live upon asparagus, but *C. duodecim-punctata* is rare in Britain. In early spring, the beetles, which have just emerged from the ground, attack the young asparagus-shoots from without, and the six-legged larvæ, which do not appear till May, do the same. They are leaden grey or greyish green, and usually smeared with their droppings, which protects them from the attacks of their enemies. When about to pupate, they enter the ground and make an oval cocoon, mixed with particles of earth.

The beetles appear for the second time in large numbers in August, and stick their bottle-shaped eggs perpendicularly on the stalks and branches of the asparagus plants which have sprung up in the meantime, from which they afterwards often strip off all the green parts in company with innumerable larvæ. The larvæ of the second species named also attack the berries of the asparagus, which then redden prematurely. The beetles are readily seen, and may be beaten off into an open umbrella. The short-legged larvæ, which have a firmer hold, are best destroyed by dusting the plants with lime or coal dust after a heavy dew.

Another enemy to the asparagus is the Asparagus Fly (*Platyparæa pœcilloptera*, Schrank), which closely resembles the Cherry Fly (Plate 28, fig. 4.)

The Wheat Ground Beetle (*Zabrus gibbus*, Fabr.)

Plate 11, *fig.* 1.

Although nearly all the ground beetles are carnivorous, the present species is sometimes very injurious to crops. This pitchy black beetle is distinguished from its allies by the more convex shape of its body. It is met with from June everywhere in the fields, but, like most other ground beetles, it remains generally hidden in the daytime. At night it climbs up the stalks of half ripe corn and feeds upon the tender grain, commencing at the base of the ears. Whilst doing so, it clings so tightly to the ears that its hold is not loosened by gusts of wind. As the corn ripens, it only gnaws off the upper parts of the grain. While the beetle causes extensive damage in this way, the larva is still worse, for in spring and autumn it gnaws the young plants near the ground, so that only the veins of the leaves are left. The larvæ feed at night, like the beetles. In the daytime they conceal themselves in an almost vertical tunnel of their own construction. At the bottom of this they change about the middle of May into a delicate white pupa with black eyes, and the beetle emerges in June. The beetle and larva probably feed usually on small animals and wild grasses, and only attack the corn when in unusual numbers.

If their ravages are noticed in June or July, the beetles should be brushed from the ears between the hours of half-past eight in the evening and seven in the morning (using a lantern if necessary), and may be dropped into a bottle containing turpentine, or some similar substance, to benumb them. When home is reached, they should be thrown into boiling water to make sure of killing them. As the eggs, and afterwards the larvæ, will be found in the same fields as the beetles, it is necessary to deprive the larvæ of food by deeply ploughing in the after-growth as soon as possible, and waiting to sow the new crop till late in the autumn. The alternation of a crop of potatoes, turnips, etc., in the infested fields, and those adjoining, if possible, will also diminish the number of beetles. Where the ravages of the larvæ are seen, watering with liquid manure, undiluted after rain, but diluted in dry weather, is said to be a good preventive.

The Black Carrion Beetle (*Silpha atrata*, Linn).

Plate 11, *fig.* 2.

As is denoted by its name this beetle is not originally a plant-eating beetle, but one of those which feeds upon carrion. Both the beetle and its larva may often be met with on the carcasses of small animals; generally beneath them. The larvæ are black above, and with a rather hard cuticle, but paler and softer beneath. Their shape, broad in front and narrowed behind, bears some resemblance to that of the silver-fish which are found in houses among old papers. Near the end of the tail are two points directed backwards.

Amongst the injurious insects must be numbered the larva, which, in the absence of carrion, will attack turnips, beetroot, etc., in large numbers, eating the young plants entirely, and leaving only the skeleton of the leaves of the older ones. The beetle has also been accused of similar habits. Probably the larvæ are only driven to this kind of food when their numbers have increased to such an extent that they are unable to obtain sufficient animal food, and in this case they will cause great destruction, owing to their voracious habits, for there are only short intervals at the four moults when they do not feed. In bad weather they creep into the ground, and here the pupa rests. The beetle also hibernates in the ground. In April it appears again, and in the first warm days lays its round white eggs in the ground with its extensile ovipositor.

The only certain precaution which has as yet been of avail has been to pick off the larvæ and beetles, which can be done by children.

On Plate 11, fig. 3, the Small Chafer (*Rhizotrogus solstitialis*, Linn.) is shown. Its larvæ live in the ground and are destructive in a similar way to those of the Cockchafer, which they closely resemble, whilst the beetle lives upon the leaves of various trees.

D.—INSECTS LIVING UPON FLOWERS.

The Rape-Flower Beetle (*Meligethes æneus*, Linn.)

Plate 12, *fig.* 1.

This little beetle, which is only one-tenth of an inch in length, is black with a greenish metallic lustre. It appears in early spring on all kinds of flowers in gardens and fields, and its fine grey pubescence is generally dusted with pollen. But as soon as the rape and turnip fields come into flower it will be found there in large numbers. The beetle feeds upon the closed buds as well as upon the open flowers, although it lays its eggs singly in the heart of the buds. The larva, which emerges in about a week, feeds upon the parts of the flower, which are consequently infertile, or they gnaw the young seed-capsules. At the beginning of June the larva attains maturity, drops to the ground, and pupates at a slight depth. The fresh brood of beetles appears towards the end of June and lives throughout the summer on a variety of flowers until the cool autumn weather drives the beetles into their winter quarters in the ground.

When they appear in large numbers their injuries are often considerable, and steps must be taken to destroy them. Good results have been obtained by the following means:—

Boys were sent to walk between the rape which had been sown in rows, holding a wet beetle-net in one hand, and shaking the flowering plants over the net with the other. From time to time the beetles were shaken out of the net into a bag, and its contents were killed in boiling water. The collecting of the beetles was suspended during the noon-day heat, as they are then too lively, and on cold days, as they then conceal themselves.

The yield of the field thus treated was found to be considerably better than that of the neighbouring fields, where the beetles had not been collected.

E.—INSECTS LIVING UPON FRUITS.

The Clouded-yellow Pearl Moth (*Orobena extimalis*, Scop.)

Plate 12, *fig.* 2.

The caterpillar of this small moth is represented on our plate in the jaws of a tiger beetle. It lives on various late-flowering, wild and cultivated *Cruciferæ*, and its presence is easily detected by a fine web which it spins between the young pods. Protected by this, it eats round holes in the pods to reach the seeds, which gives the shoots a whistle or flute-like appearance.

The caterpillar hibernates unchanged in a thick web just under the surface of the ground.

Deep ploughing after the rape has been harvested would probably destroy most of the caterpillars.

The Corn Thrips (*Thrips cerealium*, Halid.)

Plate 12, *fig.* 3.

Between the sheaths of the unripe ears of corn and in the furrow of the grains we often find active slender little insects, with a very movable abdomen. These are called Thrips, and have translucent bladder-like pulvilli upon their feet instead of claws. The perfect insects are about one-twelfth of an inch in length, and pitchy brown or black, whilst the larvæ are bright orange-coloured. The larvæ and the mature males are apterous, but the females have four wings with long cilia.

These insects are often found on corn in large numbers, and cause much destruction of grain by their sucking. Sometimes the females of this and probably of other species swarm on hot days during harvest-time, in such numbers, that the slight tickling which they produce on the skin is very troublesome, both indoors and out.

Thrips are found hibernating in all sorts of places, but especially among stubble. Burning the stubble or ploughing it in would certainly reduce the numbers of the little pests somewhat, but would not prevent their appearance in the next year, as they also infest meadow grass.

USEFUL INSECTS.

On plate 12, in addition to the above-named pests, there are also depicted two useful beetles.

The slender-legged green beetle (Plate 12, fig. 4c) which is represented as about to pierce the caterpillar with its sickle-shaped jaws, is the Green Tiger Beetle, a carnivorous beetle equally expert in running and flying, which is common in sandy places. To the right, watching at the mouth of its burrow, is its equally ferocious larva, waiting for some small insect to come within reach, which it seizes in its great jaws and drags down into its den. The pupa, which remains in the burrow after the entrance has been closed, has an equally curious appearance.

The second carnivorous beetle (Plate 12, fig. 5) is one of the Rove Beetles (*Staphylinus cæsareus*, Cederh.) It is represented preparing to take flight, which is shown by the position of the very movable abdomen. Presently the twice folded membranous wings will be expanded from under the short horny wing-cases.

The Pea Beetle (*Bruchus pisi*, Linn.)

Plate 13, *fig.* 1.

Sometimes a large number of peas are found in the spring to have a smooth round hole in them, and if we examine these we may find a small beetle about one-fifth of an inch long resting in one of these holes under a circular lid formed of the skin of the pea.

The pea beetle both in its larval and pupal state is harvested with the crop, and afterwards takes the opportunity of escaping when the peas are sown. It then flies again about the fields or in the gardens, and lays its eggs when the peas are in bloom, or in the young pods.

Small quantities of peas which are intended for garden sowing can best be freed from their uninvited guests by hanging them up in thick bags in a warm place. The beetles will then quit the pods, gather on the inside of the bag, and may be killed with boiling water.

Taschenberg gives the following recommendations which with some alterations would be applicable either to a large or small quantity of peas.

Experience has shown that leguminous seeds do not lose their germinating power if exposed to a heat of 125° Fahrenheit, whilst any larvæ or pupæ infesting them are destroyed by this temperature. If therefore the peas be exposed to this heat soon after gathering, in such a way that they are all alike heated to this point, but not beyond, the fields sown with them next year will be free from this pest.

The Corn Weevil (*Calandra granaria*, Linn.)

Plate 13, *fig.* 2.

Corn is not safe from the attacks of insects even in the granary. One of the worst enemies of stored corn is the corn weevil, an elongated, dark brown beetle, with light brown legs and a long proboscis, which measures about one-seventh of an inch in length without the trunk. It was originally a native of warm climates, and is much more destructive in warm seasons than in cold.

Directly the warmth of spring has enticed the beetles out of their winter quarters in the cracks and crevices of the granary, they begin to breed. The female gnaws a tiny hole through the outer husk of a grain of corn, appearing to give the preference to wheat or rye, and therein lays a whitish egg. The larva completely eats out the grain, and eventually enters the pupa-state in the cavity, which it entirely fills. The young beetles make their way out at the beginning of July, and soon provide a second brood, which is developed by the end of September. As a single female is said to lay as many as 150 eggs, it is easy to see that a heap of corn which remains stored during the summer can become quite "lively" by this time. The beetles which now emerge, gnaw the outside of the grains in autumn, but they do not breed again before winter, so there are no larvæ or pupæ during the winter.

Careful ventilation of the granary, and frequent turning over of the corn will usually keep away the beetles, but where they have gained a footing, the following methods of driving them away, and of destroying them, may be resorted to.

As the beetles require plenty of warmth for their development, it is necessary to keep the interior of the heaps of grain cool. For this purpose drain tubes should be inserted at intervals of about three yards, opening into an air shaft either separately or together. By this contrivance the weevils will not only be driven away, but the frequent turning over of the corn will be rendered unnecessary.

The beetles may be enticed by sheepskins spread under the heaps of corn, which should be laid with the rough side downwards. The skins are now and then carefully lifted, beaten over a wide vessel, and the beetles killed with boiling water.

This should be done three times a year. in spring, when the beetles leave their winter quarters; at the beginning of July, when the first brood has emerged: and about the end of September, when the second brood retires to its winter quarters.

In addition to the actual damage caused by the weevil, it may be mentioned that corn infested by it is extremely unwholesome.

The Corn Moth (*Tinea granella*, Linn.)

Plate 13, *fig.* 3.

If the woodwork of an old granary be carefully examined in June, it will be noticed that from between the cracks and crevices tiny, empty pupa cases project, with the hinder end sticking in a silky pad. The numerous silvery moths, with dark spots on the fore-wings, which hang everywhere in the spiders' webs, or flutter about the windows in the evening, have emerged from these pupæ. This is the corn moth, a widely-distributed and very destructive insect. It swarms at night, and lays a hundred eggs or more on various kinds of stored grain. The little sixteen-legged caterpillar which emerges in from ten to fourteen days, is whitish, with a light brown head, and, when full grown, measures two-fifths of an inch in length. It spins a few grains together, and partially eats them out under this protective covering. If the corn remains for a long time undisturbed, there will eventually be found only small fragments of grain spun together, and grey droppings. The full-grown larvæ leave their webs and wander about in search of a suitable place in which to assume the pupa-state. Their course is indicated by threads with which the heaps of corn are sometimes covered, as if with a silken net. Some of the caterpillars remain in the heap, but most of them seek a shelter in the cracks of the woodwork, and spin a cocoon round them, mixed with particles of wood or grain, and in this they remain until March, or still longer, unchanged. In June the moths emerge from the pupæ.

If vessels of water are placed on the floor of the granary in June, when the moths are flying about, many will be drowned in them, as they are fond of sipping water. At this time, too, the corn should be frequently shovelled about, to check the development of the brood. If the caterpillar's webs are observed on the heap, the upper layer should be carefully removed, and used as food for cattle. Finally, the granary must be thoroughly cleaned, and the walls and woodwork should be painted with lime, carbolic acid, or tar.

II.—Insects Injurious to Fruit Trees.

A.—INSECTS INJURIOUS TO THE ROOTS.

The Cockchafer (*Melolontha vulgaris.*)

Page 7, plate 1.

B.—INSECTS INJURIOUS TO THE TRUNK AND BRANCHES.

The Apple Bark-Beetle (*Bostrichus dispar*, Hellw.)

Plate 14, *fig.* 1.

Although this is the only species of bark-beetle which we have included in our illustrations, there are many other species which are injurious to forest trees. The apple bark-beetle is, however, exceedingly injurious in gardens and orchards. The male and female differ both in size and shape (*see figures*). The beetle sometimes appears suddenly in orchards, and attacks and destroys young apple trees about as thick as a finger, which have recently been green and healthy, and have perhaps even flowered.

The female bores its way into the lower surface of a branch in May (the male is rarely seen) and forms a semi-circular gallery in the sap-wood, just beneath the bark. It then excavates several perpendicular passages both upwards and downwards, for the larvæ, which soon develop from the eggs laid therein. The rising sap, which flows very strongly, exudes into the galleries, and forms a rich nourishment for the larvæ, probably mixed with saw-dust. A sour smell (due to fermentation) rises from the fresh galleries; the sides are dark coloured, but covered with a whitish substance, which forms the food of the larvæ. These are white and slender. and are distinguished from the rest of their kind by their small head and weakly developed jaws. This, as well as the structure of the galleries, seems to indicate that the larvæ do not themselves bore— a remarkable deviation in the habits of this beetle from the allied species. The larvæ pupate in the galleries, and the beetles, which are fully developer n July and August remain in them for some time longer.

All that can be done against this pest is to cut off and burn the infested shoots, although it may sometimes be possible to cut out the beetle which is just piercing the bark before the sap has begun to exude.

The Plum-tree Borer (*Scolytus pruni*, Ratzb.)

Plate 14, *fig.* 2.

If old plum trees are allowed to remain in the orchard, they are liable to become infested by this beetle, and also by a smaller species of the same genus, the Small Plum-tree Borer (*Scolytus rugulosus*, Ratzb.) The larger species is about one-sixth of an inch in length, and bores into trunks and branches which are not too thick; the smaller species, which is about half the size, attacks especially the smaller branches and twigs. Both penetrate the sap-wood, and here they form a main gallery, which is generally curved. The eggs are laid in small crevices on the sides, and from each crevice a larva eventually forms a winding passage, gradually expanding, through the inner bark, which conveys the descending sap, but when the bark is thin the gallery extends into the sap-wood. Their development is slow, and at the beginning of May in the next year a few larvæ may be found among the pupæ, which rest in the bark. It is only on very warm days that the beetles emerge from the pupæ and fly among the trees. There may be a considerable interval between two suitable days, and the whole period of flight may extend from May to July. When all the pupa-cases are empty, the bark of an infested tree looks as if it had been riddled with shot. The bark dies as far as the passages of the larvæ extend, even whilst they are feeding. The beetles sometimes bore into the same tree, after pairing, as long as it remains green. They always prefer sickly trees to sound ones, as the strong flow of sap interferes with their perforating the latter.

In order to guard against these beetles, which attack apple and cherry trees, etc., as well as plum trees, all sickly and badly growing trees should be removed, and the healthy ones should be well manured, and carefully pruned. If some perforations should be noticed at the time of the flight of the beetles, indicating that a tree has been attacked by them, these should be cut out, and afterwards the bark should be removed from such spots as far as the galleries of the larvæ extend. All infested trunks and branches should be burnt.

The Goat Moth (*Trypanus cossus*, Linn.)

Plate 15.

The large flesh-coloured caterpillars of this moth are well known to everyone who has felled old willows, as they frequently bore in the soft wood of these trees in considerable numbers. They are also found commonly in fruit and forest trees, including oaks, and they may kill the trees, as their wide galleries permeate the sap-wood in all directions. They soon abandon dead trees. Their presence is betrayed by an unpleasant odour, which clings to everything that the caterpillar touches. If the caterpillar is suddenly alarmed, it squirts out a fluid having the same smell, to drive away the offender. The fluid is projected from its mouth, which is not placed beneath the head, but in front, for the purpose of boring. It is only after two, or even three, winters that the caterpillar changes into a brown pupa, enclosed in a coarse cocoon, mixed with fragments of wood, which generally closes the outlet of a gallery. The moth emerges in June or July. The pupa first pushes itself out of the cocoon by means of the spines on the abdomen, and of a pointed projection on the front of the head, till the front of the body projects from the tree. This usually occurs in the afternoon. but the stout-bodied moth remains motionless. resting on the stem till night, and it will take a practised eye to detect it from the surrounding bark, in spite of its large size. This is an instance of protective colouring.

Pairing and oviposition take place at night. The sluggish female never attempts any long flight. It thrusts its eggs, which are at first whitish, into the crevices, and under the scales of the bark of the nearest tree, by means of the extensile soft end of the abdomen, and covers them with a brownish fluid, which quickly hardens, and thus glues them to the tree. The young caterpillars are found gregariously in autumn, boring under the bark. It is difficult to destroy the larvæ, owing to their concealed habits. The moths may be sought for, and killed, from the middle of June to the middle of July, the best time being about seven o'clock in the evening.

The Stalk-boring Weevil (*Rhynchites conicus*, Illig.)

Plate 16, *fig.* 1

This little beetle is only one-eighth of an inch in length, without the proboscis. It is deep blue, with darker pubescence. It lives in May and June, after the trees are in leaf, on such fruit and forest trees as are suitable for its nourishment. It first notches the under surface of a tender young shoot, after which it climbs higher up, and here pierces a hole to the pith. It then lays an egg on the edge of the puncture and pushes it to the bottom of the hole with its proboscis. If the cavity is deep, a second and even a third egg may be inserted in it, in the same manner. The little beetle then returns to its first notch, and cuts through the shoot completely, so that it hangs only by a few fibres, and is soon blown away by the wind. Each egg involves an hour's labour, and cutting off the shoot fully as long. The beetle proceeds in this manner for some weeks.

The footless larvæ now develop in the withering shoot, and the damper the weather is, the better they develop, as their food remains softer and more juicy. After feeding for four weeks, they go into the ground to pupate. The beetles sometimes appear in autumn, and as in the spring, feed upon the leaves, but they only breed after hibernating.

The only important injury which they can do is by cutting off the young shoots, and it is therefore seldom necessary to take steps against them except in nurseries. The beetles may be shaken or beaten nto an open umbrella, which is held under the trees, and they may then be killed. All fallen twigs should also be collected immediately, and burnt.

The Woolly Aphis (*Schizoneura lanigera*, Hausm.)

Plate 16, *fig.* 2.

This aphis is a most dangerous foe to the apple tree; when squeezed it emits a red fluid. Although the little creatures are only one-twelfth of an inch long, great injury is caused by the combined sucking of many thousands or millions of them, which settle in colonies on abrasions of the bark on young branches or towards the root.

The irritation of their suction causes a stronger flow of sap towards the spot. This causes excrescences in the loose tissue, in which the *Aphidæ* at once sink their probosces again. Eventually the continually strained bark gives way, causing cracks and unhealthy surfaces, which form excellent hiding places and fresh points of attack for the *Aphidæ*. If frost or fungus hastens the decay of the tree, one branch after another dies, and the tree is gradually destroyed.

A colony of *Aphidæ* is easily recognized by a bluish white flocculent covering, consisting of a wax-like substance which exudes from the *Aphidæ*, mixed with cast skins and droppings. Yellowish droplets of honey are often seen among the wool, which is also a secretion of the *Aphidæ*. If the wool is removed with a soft brush the separate animals are seen, of different sizes, close together, and heaped on one another.

All the *Aphidæ* met with in summer are females, which are full-grown in two or three weeks, and then bring forth from thirty to forty living young. If there is not room for these beside the parents on the abraded spot, they wander away and form new colonies. This mode of reproduction proceeds continuously from April till late in the autumn, and as we must reckon at least eight broods, all of them females, which are fertile without pairing, it is possible for the descendants of a single aphis to amount to millions in a year.

In the autumn, among the wingless females, winged females are also met with. These fly about on warm days, and are often transported to a considerable distance by the wind, until they alight on some apple tree, and there give birth to from five to ten young ones of various sizes and colours. These are sexually-developed animals: the larger, which are yellowish, are females; and the smaller ones, which are greenish, are males. The mouth apparatus of both is undeveloped, and they can therefore take no nourishment. Their one function is to reproduce their kind sexually. Each female lays only a single reddish yellow egg in a chink in the bark, from which a larva emerges the same autumn, which hibernates, and in the following spring becomes an hereditarily fertile female.

Besides these sexual founders, many of the fertile asexual forms also hibernate, and though hard frost and ice may diminish their numbers considerably, a fresh brood is always found on the infested areas, if no means have been taken to destroy them.

The incursions of the *Aphidæ* may be hindered by carefully cleaning the bark of the tree, and cutting out all injured parts smoothly, and smearing them with grafting wax, tar, or a mixture of clay and fresh cow-dung. Above all things it is necessary to be careful in choosing young trees and grafts to make sure that they are quite free from *Aphidæ*.

The following methods have proved effective:—

Nessler's mixture: 1 part of soft soap

is completely dissolved in 13 parts of warm water, and to the solution, when cool, are added two parts of fusel oil (amyl alcohol), and 4 parts of spirits of wine. This mixture has the peculiarity that each drop spreads at once on the surface, whether the surface be dry or wet, so that it penetrates into all the crevices and kills the *Aphidæ* which are concealed there.

Prof. Mühlberg, of Aarau, recommends the omission of the spirits of wine, and the addition of only 7 parts of soap to the water, and of 12 parts of fusel oil.

Both solutions must be well shaken before using.

It is important that the infested tree should be treated thus from the end of the branches to the roots, since if a single aphis escapes, it may restock a whole tree in a few months. It will rarely be necessary to disinfect the roots also, but in such cases the larger roots should be uncovered, and deluged with the mixture.

Several *Coccidæ*, with shield-like hard or tough coverings, suck the bark of fruit trees and bushes. In addition to the Apple Coccus (Plate 16, fig. 3), another species, the Apple-tree Mussel-scale (*Mytilaspis pomorum*, Bouché), which occasionally appears on apple trees, is particularly destructive. One remedy is to paint the tree with lime in the autumn; another is to scrape the affected parts with a wooden knife, so as to crush the females without damaging the bark, and then to apply gas-tar.

C.—INSECTS FEEDING ON LEAVES.

The Cockchafer.

Page 7, Plate 1.

The Black-veined White Butterfly (*Aporia cratægi*, Linn.)

Plate 17.

The Black-veined White is distinguished at once from the Common White Butterfly by the conspicuous black nervures on the wings, which broaden towards the margins. A fine black marginal line borders both the front and the hind wings.

The female chooses a fruit tree or an allied wild plant, and lays from sixty to a hundred and fifty yellow pear-shaped eggs close together on the upper surface of a leaf. After about fourteen days the little caterpillars appear, which spin a silken covering for themselves, and beneath this they eat off the surface of the leaf in the same way as the caterpillars of the brown-tail moth (Plate 19, fig. *a*.) They also form their winter quarters in a similar way to that insect from leaves surrounded by threads, having chambers, each of which conceals a single caterpillar only; but the nests of the black-veined white butterfly are smaller than those of the brown-tail moth, so that they frequently only enclose one leaf. In the following spring the caterpillars, which are adorned with three black and two yellowish brown longitudinal stripes, and are covered with lighter hair, become very voracious. The old nest soon becomes too small for them, and a larger one is constructed, from which convenient paths are constructed of threads to the feeding grounds. They are full-grown at the end of May, and each now seeks a place to pupate in, on or near the tree, and fixes itself there with a few threads by its hinder extremity, and a belt round its middle. The chrysalis resembles that of the cabbage white in size and shape, but the projections are less pointed. The butterfly emerges about June.

We have figured this butterfly as an interesting species which is always more or less uncertain in appearance, though it is sometimes sufficiently abundant to cause considerable damage on the continent. It was always a local insect in England, but, from some unexplained cause, it has become so rare during the last few years that it appears to be on the verge of actual extinction as a British species.

There could not be a more striking instance of the fact that the abundance or rarity of an insect is frequently quite independent of that of its food-plants, for the caterpillar of the Black-veined White Butterfly feeds on hawthorn and sloe and others of our commonest trees and shrubs.

Although the present rarity of the insect in England renders it very improbable that it will ever become a pest, yet we may mention that its numbers have been greatly reduced in localities on the Continent, where it was injuriously abundant, by collecting and destroying the caterpillars' nests early in the year on the still leafless trees.

The Brown-tail Moth (*Porthesia chrysorrhœa*, Linn.)

Plates 18 *and* 19.

The caterpillars of this moth, and of the closely allied gold-tail moth, make the large nests (Plate 19, fig. *b*.), which may be easily found and destroyed in winter on the bare trees. The egg-laying female has a peculiar appearance. The shining, silky white wings are held sloping, and it sits apparently lifeless under a leaf. Only the extremity of the abdomen shows life, as it fixes one egg after another on the surface of the leaf, and at the same time rubs off a portion of the shining, rusty brown anal tuft to form a felt-like covering for them, so that the egg-mass resembles a strip of tinder, and looks as if it were only a prolongation of the abdomen. Of the two or three hundred eggs themselves nothing is visible. After the laying is finished, the vitality of the female is exhausted, as is the case with most of the allied species. The male also dies soon after pairing. It is distinguished by the long, light brown pectinations of the white antennæ, and by the abdomen, which is rusty brown almost to the base. The little caterpillars which emerge from the eggs in two or three weeks' time, in August, take their first food from the leaf which served as their cradle. They spin threads from edge to edge of the leaf, and under cover of this they eat away the green portion of the leaf from the upper surface. They then proceed to the next leaf, taking the precaution, however, of first attaching it to the branch with threads, so that it cannot fall off. Other leaves are similarly fastened and eaten off, till the cool autumn days warn the caterpillars that it is time to prepare their winter quarters. Under the protective covering of threads and leaves, usually on the latter themselves, they now make cells, varying in size from a pin's head to a pea, prepared with smooth, silky walls, each of which shelters two or more of the caterpillars from the inclemency of the weather during winter. In the following spring the caterpillars soon make themselves conspicuous by their ravages, first on the buds and afterwards on the flowers and leaves, which they now entirely devour. At first they return regularly to the nest, but afterwards they prepare webs near their feeding places as a protection from the weather, till after the third moult—about the end of May—when they disperse themselves over the trees. About June the caterpillars pupate singly, or in company, between leaves spun together. The whitish cocoon is mixed with the brownish grey hairs of the caterpillar, but is so loose that the dark brown chrysalis and cast larval skin can be seen through it. In July the moth appears, flying only by night.

The best and easiest method of combating the Brown and Gold-tail moths is to destroy their nests in winter. The search for pupæ must be undertaken cautiously, as the caterpillar's hairs woven into the cocoon become detached at the least touch, and easily penetrate the skin, causing inflammation.

The Lackey Moth (*Gastropacha neustria*, Linn.)

Plate 20.

Many fruit-growers must now and then have noticed, when pruning, a little twig which appeared as though wearing a broad ring of threaded beads. They are the eggs of the lackey moth, which are laid in this manner. The eggs are so firmly attached to one another by a blackish substance, that they will still keep the form of a ring, if pushed off the cut twig. The caterpillars, which emerge in April or May, cover their birthplace with numerous threads, and only quit this protective web to appease their hunger on the neighbouring buds. They soon wander further afield, and feed gregariously on the young leaves; but they still rest together in a web which is generally fixed on the fork of a branch, and this protects them from sunshine and rain, especially at moulting time. After each moult, the bright stripes, which have earned for them the name of Lackeys, become more and more conspicuous. Finally the caterpillars disperse, and each chooses a place in which to pupate, between leaves, on bark, on fences, walls, or wherever else they can find a hiding place. The inner and denser portion of the whitish cocoon is rendered quite opaque by a yellow powder, so that the dark brown pupa is not seen through it. After a short time in the pupa-state, the moth appears in June or July.

Preventive measures. In the case of

small trees it is easy to find the egg rings, after the fall of the leaf, and these should be cut off and burnt; whilst in the case of larger trees, the caterpillars' nests can best be reached with a broom, or by firing into the trees half a charge of loose powder.

The Gipsy Moth (*Porthetria dispar*, Linn.)

Plate 21.

In few insects do we find such a difference between the sexes, in size, form and colour as in the Gipsy Moth. The stout sluggish female generally sits with sloping wings upon the trunk of a tree, and here lays its eggs, which it covers over with the greyish brown hair from the tuft at the end of the abdomen, so that nothing can be seen of the eggs themselves, the whole egg-mass looking like a piece of tinder. In July and August the females may be met with thus employed, and can be destroyed, together with their eggs. Careful gardeners will easily find the eggs when examining the trees in autumn;

but the walls, fences, and posts enclosing the orchard should also be examined for egg-clusters. The caterpillars, which emerge early in the spring, at first sit on the egg mass and cover this and their surroundings with slender threads, and it is said that if they find no food there, they allow themselves to be blown away on this web by the wind in order to reach a food-plant. There are few trees whose leaves they will not touch; no fruit tree is safe from them, and as each mass of eggs often yields from three hundred to five hundred caterpillars, the trees may be much damaged by them. The caterpillars of the gipsy moth are readily distinguished from all other caterpillars by the eleven pairs of warts on the back, set with long stiff hairs, the first five pairs of which are blue, and the six hinder ones red. After the last moult the head is disproportionately large. The caterpillars are most easily killed when they have crowded together on the under surface of the branches during wet weather, either by fumigation, or by squeezing them in the hand, which must be protected from the very irritating hairs by an old leathern glove. In June the caterpillars, which have long before dispersed over the tree, seek for hiding places on the trunk, under window-sills, or on palings, spin light cocoons, and change into bluish brown chrysalids with yellow tufts of hair, which can be collected and destroyed.

Although the gipsy moth is very common and destructive on the Continent, and latterly in America, where it was accidently introduced a few years ago, it has always been very rare in England, except in a part of the fen district which is now drained, since when it has become extinct there. However, as there is always a possibility of its being re-introduced from the Continent, we have decided to include it in the present work. We may add that the male moth flies about hedges and bushes in the daytime, almost like a butterfly.

The Figure of 8 Moth (*Diloba cæruleocephala*, Linn.)

Plate 22.

The stout cylindrical bluish-headed caterpillar of the figure of 8 moth lives on hawthorn and sloe and upon various fruit trees. It is not met with in large companies, but is sufficiently common for its ravages on the foliage to be very conspicuous. The ground-colour, at first greyish white, becomes after the last moult yellowish green, whilst the pale yellow longitudinal stripes, the black hairy warts, and the two black spots on the head, make the caterpillar easy to identify. It feeds from the opening of the leaves to the end of June. It then spins, generally on the lower part of the trunk, a paper-like cocoon, mixed with grains of sand, moss, or anything suitable which is at hand, so that it is not easy to discover. The pupation does not occur for a month or more, and the moth appears only in the autumn, at the earliest at the end of September, so that it can fix its greenish eggs singly on the trunks and branches of the above-mentioned trees, before winter.

The caterpillars can easily be shaken from the trees and then killed.

The Winter Moth (*Cheimatobia brumata*, Linn.)

Plate 23.

The winter moth flies on mild evenings in November and December until about ten o'clock. This applies only to the male, for the female has only short rudiments of wings, and hardly looks like a moth. It climbs a tree, where it is visited by the male, and after pairing, it lays two or three hundred greenish eggs, which afterwards become reddish yellow. These are divided into small masses, and are attached to the buds. The small ten-legged caterpillars emerge before the sprouting of the leaves, spin over the buds, and feed upon them, often completely eating out the interior. Only rapid growth from favourable weather can burst the silk in time to allow the leaf to expand, though it will still show evidence of the mischief which has been done already. Then the caterpillar attaches some leaves together, and continues to feed beneath this covering. If the caterpillars are in large numbers, they may damage the trees very considerably, for they do not quit one tree for another until they have completely defoliated the first. In this way they can not only prevent a tree from bearing during the same year, but may completely destroy it. As early as May, and not later than the beginning of June, the caterpillars let themselves down from the trees by threads, and bore to a depth of two or three inches into the ground, where they enter the pupa-state in a rounded cavity.

Many of these chrysalids can be destroyed by digging somewhat deeply round the trunk of a tree. The best prevention is however by painting a ring of lime or tar round the trunk to prevent the females from climbing up. Sometimes this application is spread on paper or straw.

The Small Apple Ermine Moth (*Hyponomeuta malinella*, Zeller).

Plate 24.

Scarcely has the apple tree sprouted into leaf than loose webs of sticky threads appear spread out here and there among the twigs, in which hundreds of slender yellowish or brownish grey little caterpillars, dotted with black, climb about, and eat all the green off the enclosed leaves, leaving only the skeletons. When the leaves which are within reach of the first web have been eaten, the caterpillars look for a new feeding place. Thus a company of caterpillars will sometimes prepare eight webs one after another, and if several broods live upon one tree, all the green gradually disappears, and finally all the twigs become covered with webs. In June the webs contain stout yellow chrysalids, instead of caterpillars, crowded together in an upright position, sometimes a hundred or more in one mass, each of which is enclosed in a separate transparent cocoon. The moths emerge before the middle of July. They have silky white fore wings sprinkled with black dots, and white hind wings. They soon lay eggs again on the branches, and the small larvæ emerge before the autumn, but without doing much mischief the same year.

As soon as the nests of these caterpillars are met with, they should be smoked out, or the caterpillars may be crushed with the hand, but in so doing care must be taken that none escape; for at the slightest disturbance the caterpillars wriggle backwards out of the webs, and lower themselves by threads.

The Plant Lice (*Aphis*, Linn.)

Plate 25, *fig.* 1.

The mischief which the plant lice cause to cultivated plants is too obvious to render it necessary to quote special instances. In the orchard they destroy or impair the crop of many trees and bushes, by draining the leaves and young shoots by constant suction. In the kitchen garden they injure or destroy all sorts of vegetables, whilst in the fields they attack the corn, and especially pulse, upon which they often become so numerous that the farmer is unable to contend against them.

The life history and mode of reproduction of the plant lice in general are essentially the same as those of the woolly aphis, from which most of them differ by the tubes on the back of the abdomen. The sugary secretion from the anus, which they often squirt to a considerable distance, forms a sticky, shining covering on the leaves (honey-dew), which stops up the pores of the leaves, and is thus injurious to them. From April till winter hereditarily fertile females, producing living young, are to be found, mostly wingless, but some winged. The latter often found a new colony upon plants at a distance. In the autumn, both males and females are born, of which the latter are wingless. These females lay comparatively large winter eggs, out of which emerge larvæ in the following spring, which again develop into females producing living young. In the orchard these eggs are often found in considerable numbers on the young twigs, resembling grains of gunpowder. It is these which are so eagerly sought for in the winter by titmice, which pick them from the twigs. The plant lice themselves are also eagerly devoured by wrens, titmice, and other small insectivorous birds.

Methods of destruction. On dwarf fruit trees and espaliers, as well as in nurseries, the younger branches should be examined in the winter for eggs; the former should be painted with lime water, and all twigs which are too much infested should be cut off and burnt. In the spring, from April onwards, the first colonies of plant lice should be destroyed, which will perhaps prevent a progeny of millions.

For the destruction of plant lice, on a large scale, the means recommended under the woolly aphis are suitable. We may also make use of strong soap suds, or a decoction of quassia and strong tobacco mixed with soft soap in the following proportions: water, one quart; quassia chips, two ounces; tobacco, two ounces; and a tablespoonful of soap are well boiled together, and when cold applied with a brush or syringe. Tobacco water is also useful.

USEFUL INSECTS.

On plate 25 we have represented a variety of enemies to the plant lice.

On the lower leaf, to the left of the plate, is the seven-spot lady-bird (*Coccinella septempunctata*, Linn.), with its larva, clearing the leaf of *Aphides*. The pupa hangs below the leaf.

The pretty Hover Fly (*Syrphus seleniticus*, Meig.), *fig.* 3*c*, which lives upon the nectar and pollen of flowers, has a handsome leech-shaped larva (3*a*), which is represented feeding upon the plant lice: and a stout pupa pointed behind (3*b*).

Who would recognize in the little fungus-like forms, on the upper leaf to the left, the eggs of the Lace-winged Fly

(*Chrysopa vulgaris*, Schneider)? From these emerge larvæ (*fig.* 4*b*), which resemble those of the lady-bird in shape, and are equally voracious, which has sometimes led to their being called the lions of the *Aphides.* But what a delicate creature is the perfect insect (*fig.* 4*e*), with its golden green eyes, its net-like wings, and its long thread-like antennæ! It would seem almost incredible that this lace-winged fly emerges from the little shapeless pupa (*fig.* 4*d*) in its narrow cocoon (4c) if we were not used to such wonderful things among insects.

The Chermes (*Psylla*, Geoff.)

Plate 25, *fig* 5.

On flowers and young shoots of pear trees one sometimes notices small dark red insects with red eyes and very sloping wings. One might at first sight confuse such a creature with an aphis; but if touched, it springs into the air like a flea, and flies away. This is the Pear Chermes (*Psylla pyri*, Schmidb.) In May and later we find its dark yellow larvæ sucking at the base of the shoots, or on the wood of the previous year. They also, like the plant lice, secrete a kind of honey-dew, which covers the twigs as a sticky crust, which afterwards becomes hard and black. When the chermes occur in large numbers, they stunt the growth of the shoots, or kill them. On the apple-tree we find the greenish yellow apple chermes (*Psylla mali*, Förster), but rarely in such large numbers as the species which infests the pear.

Prevention. The careful knocking or brushing off of the eggs and young larvæ from the young shoots, or of the growing larvæ on those of the year before is advisable. They may also be destroyed in the same way as the aphides.

The Oblong Weevil and the Silvery Weevil (*Phyllobius*, Schönh.)

Plate 25, *figs*. 6 *and* 7.

The buds and the tender young leaves of fruit-trees and of various bushes are often badly eaten by several species of weevils belonging to the above-named genus. Especially common and therefore injurious are the two species figured on plate 25. The brown beetle, called from its shape the oblong weevil (*P. oblongus*, Linn., *fig.* 6), often causes great devastation in nurseries by destroying the buds of grafted twigs. The metallic green species, called the silvery weevil (*P. argentatus*, Linn., *fig.* 7), is often found in company with the other, but is just as common on beech, lime, etc., as on fruit trees. It appears to be less particular about the kind of tree than about the tenderness of the leaves.

The beetles should be shaken down from the trees early in the morning or on cool days, into an open umbrella or cloths spread beneath.

The buds of grafts can be protected from their attacks by a coating of mud.

D.—INSECTS LIVING ON FLOWERS.

The Apple-blossom Weevil (*Anthonomus pomorum*, Linn.).

Plate 26.

When the apple trees are in full bloom many people must have noticed that a portion of the flowers do not expand, and a few days afterwards that the closed petals of these turn brown at the end when those of the open flowers begin to fall. Externally scarcely any damage can be seen. If such a burnt-up bud is now opened, it will be seen that the calyx, which in the healthy flowers is already swelling, is completely eaten out. The hollow thus formed is occupied by a dirty white, brown-headed, footless larva, or else by a very mobile pupa, the form of which shows it to be that of a weevil. The beetle itself may readily be obtained if a few of the infested buds be enclosed in a box or placed under a glass; for the pupa state only lasts about a week. The beetle makes its way through the leafy wall of its prison, and flies away. But if it is touched, it will contract, and feign death. Whilst the whole of its development from the egg to the perfect insect only requires about a month, the beetle, which does not lay its eggs before the following spring, lives until that time, whilst in most insects (as in the Cockchafer, Goat-moth, etc.) a long life as a larva is followed by a short one in the perfect state. This beetle now lives a vagabond life throughout the summer, without doing much mischief. It hibernates under moss or bark, and in the spring betakes itself to the opening buds of apple and pear trees, in which it makes a fine puncture with its long slender proboscis, and inserts a single egg in each bud which it attacks. The brood perishes if the attacked buds unfold, and consequently quickly flowering trees are but little damaged by them.

Prevention and destruction. The bark of the trees should be kept free from moss, lichens and fungi; the trees should be treated with rings of tar or bird lime in spring and autumn, as the beetles often crawl up the stems both when searching for a hibernating place and when they leave it. The beetles may be shaken or beaten from the trees on to large cloths spread below, at the time when the buds are expanding, but only on dull days or in the early morning, as they will otherwise fly away. The buds of small trees may be examined as soon as the tree flowers. and the infested buds plucked and destroyed.

E.—INSECTS LIVING IN FRUITS.

The Nut Weevil (*Balaninus nucum*, Linn.)

Plate 27, fig. 1.

Even the hazel nut in its strong shell is not safe from the attacks of insects. The half-grown nut is punctured by a very long-trunked yellowish hairy weevil. the nut weevil, which inserts an egg through this opening, which afterwards closes up. The white, brown-headed, footless larva lives on the kernel, and fills the cavity with brown grains of excrement. At length it eats a round hole through the hard shell, and, emerging, forms its pupa in the ground.

The infested nuts may be recognised by a black spot, the mark of the puncture. They should be collected when about to ripen.

The Plum Saw-Fly (*Hoplocampa fulvicornis*, Klug).

Plate 27, fig. 2

Unripe plums and damsons often show a round hole filled with droppings like those caused by the caterpillar of the codling moth. A bug-like smell proceeds from the cavity, which contains a twenty-legged reddish white larva with a yellow head. This is the larva of the plum saw-fly. It eats out the young kernel, and then bores into a second fruit ; and it attacks several others similarly during its larval life of five or six weeks. It finally enters the earth to become a pupa, and appears in April next year as a little black fly with yellow legs, when it inserts its eggs into the flowers of the tree with its saw-like ovipositor.

All the plums and damsons which it attacks fall off unripe, and so the plum saw-fly often destroys almost the whole produce of a tree.

Prevention. At the time when the plums are in blossom knock down the saw-flies into an open reversed umbrella, but this should only be done in cool weather. The infested fruit should also be shaken down, and burnt.

The Hornet (*Vespa crabro*, Linn.)

Plate 27, *fig.* 3.

The female hornets attain a length of considerably more than an inch, whilst the workers are often not much larger than common wasps.

Their habits are thus described by Taschenberg :—

"A female fertilized in the autumn forms a colony after hibernation, by building a few cells in which it lays eggs, and when the larvæ emerge from these she feeds them with suitable food, especially the chewed remains of other insects. The cells are open below; the grubs are thus compelled to cling with the sucker-like abdominal extremity to the base to avoid falling out. They become full-grown in about nine days, when each closes its cell with a semi-circular lid, and becomes a wedge-shaped pupa. From these proceed workers, which increase, enlarge the nest, and undertake the rearing of the brood, whilst the mother hornet now concerns herself solely with laying eggs. Late in the summer (at the end of September) in addition to the workers which are still produced, males and females develop. These pair as they fly out together, and, when the weather becomes severe, all die except a few females, which hibernate under moss at the foot of tree trunks, or in hollow trees and similar hiding places.

"The hornet's nest consists of several stories of comb, which are contained within a papery covering, which when completed has an opening at the side, near the bottom, for entrance and exit. Freely hanging nests are nearly round. The materials of which the nest is composed are chiefly parings of rotten wood or bark; the nest is consequently more friable and more varied in colour than those of other wasps. The nests are met with in hollow trees, less commonly in the ground, on beams in little-used and open buildings, or in a deserted bee-hive, and their presence is indicated by the hornets flying to and fro with a loud hum.

"They feed on sap oozing from trees by preference, visit trees and bushes which are much infested by aphides and coccidæ, and are very fond of ripening fruit, such as grapes, as well as bakers' and butchers' shops, in years in which they are abundant.

"In building their nests they are particularly destructive to young wood, especially to ash and white alder, as they gnaw off the young bark on one side, or round in descending spirals, right down to the sap-wood. These habits, together with their severe sting, do not make them pleasant neighbours for mankind."

The hornet is less generally common in England than the smaller wasps, but, in some years and localities, is sufficiently abundant to cause considerable trouble. Sometimes it forms its nest in the cavities of a stone wall, where it is very difficult to get at, and at other times it will form a nest of deal shavings among the rafters of a house in course of construction. The latter nests are extremely pretty objects.

For methods of extermination see the next section.

The Common Wasp (*Vespa vulgaris*, Linn.)

Plate 27, *fig.* 4.

The wasps differ little in their habits from the hornet, but the commonest species usually build their nests in the ground. The nest consists of a grey papery mass, which is composed of rotten wood. One may often see wasps gnawing diligently at old fences, rolling up the pieces removed, and flying away with them between their legs. The large nests seen hanging freely in bushes generally belong to the tree wasps (*Vespa silvestris*, Scopoli, *and V. norvegica*, Fabr.)

To keep down the number of the wasps, all the females which are met with in spring should be killed. Each of these females may otherwise become the founder of a whole nest of wasps. Later, the killing of single wasps is of little importance, but the nests should be destroyed.

This cannot always be done without risk. It is best to go at night or very early in the morning, when all the wasps are in the nest, and are sluggish. Freely suspended nests can, if their position permits, be set on fire. If this be impossible, other means must be employed. A small syringe may be used to squirt chloroform into the entrance to the nest, so as to stupefy the inhabitants; ether or benzine might also be used, but no light must be brought near on account of their inflammability. Then the nest should be removed and tied up securely in a bag, to be destroyed by plunging it into boiling water. Ground nests may be destroyed by fumigation, after stopping up all the entrances but the one through which the smoke is driven, and this must be stopped up, too, as soon as the bellows are withdrawn, or a small can of water, containing a wineglassful of benzine or oil of turpentine, may be poured through the last hole instead, after which it must be closed as already directed.

The Plum Weevil (*Rhynchites cupreus*, Linn.)

Plate 28, *fig* 1.

The habits of this pest illustrate the importance of picking up all fallen fruit and destroying it.

The beetle is of a coppery red colour with black proboscis, antennæ and legs. In May and June it attacks the fruit trees.

It first eats half through the stalk of an unripe cherry or plum, and then pierces the fruit itself, without doing much injury to the skin. Beside this opening it lays an egg, and presses it in with its proboscis, after which the skin is smoothed over. The beetle afterwards eats quite or nearly through the stalk, and the fruit falls to the ground. The fallen cherry or plum serves both as food and dwelling place to the larvæ, which is full grown in five or six weeks, and forms a pupa in the ground, where it passes the winter.

The Codling Moth (*Carpocapsa pomonella*, Linn.)

Plate 28, *fig.* 2.

Everyone is familiar with the small maggot found in apples, which damages so much fruit every year. Strictly speaking it is neither a worm nor a maggot, but a sixteen-legged caterpillar. Its galleries, which are filled with the droppings, wind through the flesh of apples and pears as far as the core, and the pippins seem particularly relished by it. Fruit which is thus attacked falls off either unripe or prematurely ripe, and the larva which often leaves them before this happens, looks for another fruit. But what becomes of this fruit destroyer?

Part of the caterpillars are full grown before the fruit harvest, and the rest at that time. The former search for hiding places in the garden, whilst the latter, which have been brought in with the fruit, search for a similar place in the storeroom. Thus the little caterpillars are soon found spun up, some out of doors, under loose bark. or in holes in the branches, and in houses hidden in cracks and crevices. After a short life of plenty follows a very long fast, for the caterpillar rests in the cocoon, taking neither food nor drink, till May. It then changes into a pupa; the end of the abdomen bears a circle of small spines to enable it to work its way out of its hiding place. The little moth emerges in June or July. It has a coppery red eyespot at the extremity of the fore-wings, and a coppery lustre on the hind-wings. It is not easily noticed when it rests in the daytime on the bark of a tree, but it is much more easily seen as it flutters about the windows of the storeroom in the evening, trying to find a way out, to lay its reddish yellow eggs singly upon unripe apples and pears.

The increase of this destructive creature may be checked in various ways; however, a visible reduction in its numbers can only be effected by a general co-operation of fruit growers. The windfalls should be picked up several times a day, and should be quickly disposed of for feeding pigs or otherwise, so that none of the worms may escape. The trees should be cleared of loose bark. but should be tied round with old rags, which must be burnt at the end of the fruit season; in these will be found large numbers of maggots in their cocoons.

The Plum Moth (*Carpocapsa funebraña*, Treitschke).

Plate 28, *fig.* 3.

This moth lives in plums and damsons in the same way as the codling moth in apples and pears. Instead of the coppery red spot, this moth has a dull leaden spot at the tip of the fore-wings. The habits, destructiveness, and means of extermination are similar to those of the former species.

The Cherry Fly (*Spilographa cerasi*, Linn.)

Plate 28, *fig* 4.

Many people have lost their appetites for cherries upon finding near the stalk a rotten place containing a little yellowish white maggot. These unbidden guests are also well known to the house-wife, and consequently she lays the cherries in water for a couple of hours before using them, to drive the maggots from their hiding places. They are the legless larvæ of the cherry fly, which is characterised by a shining black body, clear glassy wings chequered with black, yellow legs, and a partly yellow head. The fly shows itself on the ripening cherries in the warm noon-day sun, when it pierces the fruit near the stalk with its ovipositor, and inserts an egg into the hole. The wound closes and the cherry appears to be sound, till the suction of the maggot partially destroys the flesh. The larva drops to the ground, bores down for about an inch, and changes into a yellowish, barrel-shaped pupa, from which the fly does not emerge till the following May.

Prevention. Digging the ground deeply as far as the shade of the tree extends. or loosening the soil, so that the pupæ are either suffocated, or devoured by birds.

III.—Insects Injurious to Gooseberry and Currant Bushes, and to Vines.

The Yellow Gooseberry Saw-fly (*Nematus ventricosus*, Klug).

Plate 29, *fig.* 1.

As soon as the leaves have unfolded on the gooseberry bushes, leaves will be seen here and there which are perforated like a sieve. On closer inspection, very small greenish caterpillars, with scattered black tubercles, will be seen clinging to the edges of these holes, and underneath on the nervures of the leaf are the white egg shells from which they have emerged. The saw-fly, which is about a quarter of an inch long, has made a slit in the nervures of the leaves with its serrated ovipositor and inserted the eggs in rows. After the first moults the caterpillars attack the leaves from the edge, and leave nothing but the principal nervures. The first brood, on account of their small number, are as a rule confined to a few bushes. They cease feeding towards the end of May, and, soon after, the blackish cocoons are found lying near the surface of the ground, with particles of soil stuck over them. From these the second brood of saw-flies emerges about the end of June, and they are seen in swarms on the bushes, depositing their eggs. Soon afterwards feeding begins again for the second time, and their ravages now often extend to all the gooseberry bushes in the garden, and they completely strip them of their leaves. Thus the fruit is deprived of its proper nourishment, and is poor and tasteless. The pupæ of this brood hibernate in the ground.

Anyone who examines the bushes early in the year will have his attention drawn to the foe by the perforated leaves, and can collect the insects, perhaps with the aid of children, and so prevent further injury. When the larvæ have ceased feeding, the ground may be dug up as deeply as possible to destroy the pupæ. The sprinkling of the bushes after rain or dew with tobacco dust and lime is only advisable in early summer, as afterwards the ripening fruit might be damaged.

Many other saw-flies injure garden fruit in a similar manner, especially *Nematus ribesii*, which is frequently very destructive to currant bushes. It much resembles *N. ventricosus*, which we have just described.

The Currant Clearwing (*Sesia tipuliformis*, Linn.)

Plate 29, *fig.* 2.

At the time when the currant and gooseberry bushes are sprouting, young twigs will be found here and there which appear wanting in vitality, and which shoot out only sparingly, if at all. This occurs more especially in branches which have been pruned the previous year. If we split one of these branches, we shall find in the pith a long gallery leading downwards, and at the end of this a whitish, sixteen-legged caterpillar, or else a brown chrysalis in a cocoon. If we keep this chrysalis in a box we shall be rewarded by seeing the moth emerge about the middle of May. Its transparent wings and long body and legs give it some resemblance to a daddy longlegs or crane fly (*Tipula*). It is the currant clearwing, the larva of which lives in the shoots as above described.

The destruction of this pest is not easy, except by cutting off in good time the infected twigs.

This insect has been introduced with the currant into various parts of the world, notably North America and New Zealand.

The Magpie Moth (*Abraxas grossulariata*, Linn.)

Plate 29, *fig*. 3.

In this moth we have an instance of the rather rare case in which the perfect insect and its larva agree almost entirely in colour. Both are varied with white, black, and yellow, and the contrast of colour has given rise to the popular name. The moth flies in July and August, and lays its yellow eggs on the leaves of currant and gooseberry bushes, and occasionally on fruit trees. The larvæ have only ten legs, and emerge from the eggs in September. They are rather inconspicuous at first on account of their small size and dark colouring, but when they re-appear upon the bushes, after hibernating under fallen leaves, etc., they soon become very conspicuous on account of their stripping the leaves, the greater prominence of the white on their backs, and their peculiar looping gait. They stop feeding in June, and the shining black chrysalids, belted with yellow, will be found attached to the bushes by a few threads.

The caterpillars can be readily collected and destroyed, as they are easily seen.

The Vine Aphis (*Phylloxera vastatrix*, Planchon).

Plate 30.

The vine aphis is indigenous in North America, and was imported into Europe with vines. In America no serious injury to the vines had been reported from this cause. However, in 1868, Planchon proved the vine aphis to be the cause of the dying off of the vines in the South of France, which had been noticed three years previously. From 1869 to 1885, fifty-three of the seventy-seven wine-producing departments were completely devastated, and of 2,485,828 hectares* of vine land, over 1,000,000 hectares were completely devastated by the vine aphis. The damage caused in France during this period is estimated at 13½ milliards of francs. In Germany, up to 1887, about 80 hectares of vineyards had been attacked. The insect has also occasionally been met with in English grape-houses.

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* A hectare=2.47143 statute acres.

The effects may be recognized by the sausage-shaped or tube-shaped swellings, which are often angulated. These are situated on the fine tap roots, which soon turn black and decay as the result of a fungoid growth. "On the larger roots are round whitish excrescences, of a thickness of from one-twelfth to a quarter of an inch. On the principal roots the bark swells up, turns blackish, bursts, and yellowish lac-like masses appear on the bast. Then the roots die. The aphides are found sucking the swollen and diseased parts of the roots. In size they vary from one-eightieth to one-twentieth of an inch in length, according to their age. At first they are whitish yellow, or brownish in winter, but when fully grown they become green on the back, and brownish green beneath. The aphides can be distinguished with a lens, and even with the naked eye, sitting singly between each two protuberances on the young roots, gregariously on the excrescences on the stouter roots, and in large masses on the diseased main roots.

The upper portions of vines which have recently become infested with phylloxera exhibit nothing remarkable at first; but afterwards the shoots and leaves become visibly stunted, and the latter turn yellow prematurely; at length the vine dies and the wood turns black. The plants first attacked by the vine aphis form a centre of infection, which extends itself in an ever enlarging circle.

The aphides which live on roots are apterous females, with three-jointed antennæ, rudimentary eyes, and comparatively short legs. The long sheath of the proboscis lies on the under surface. From this three bristles project through a fissure, which the vine aphis plunges deep into the cellular tissue of the roots to imbibe the sap. Each female passes the winter almost motionless, but wanders about on the roots in spring and lays 30 or 40 eggs in small clusters, from which similar aphides emerge in from five to twelve days; these moult several times and are soon full grown, when they lay eggs in their turn. Thus there are six or eight broods during the summer, without any males being produced, and the annual progeny of a single female has been calculated at millions. Besides this usual process of reproduction, a second may occur under favourable circumstances. About midsummer, among the ordinary forms of phylloxera, larvæ with rudiments of wings may sometimes be noticed. These crawl up the vines from the ground, and after moulting exhibit an elongated body with developed eyes and long wings. These are also females destined to spread the species over a wider area. They lay only three or four eggs of unequal size, and generally on the under surface of the leaves in the forks of the veins, or on the buds; less frequently on the wood. From the larger eggs, mature females are hatched, and from the smaller ones males, both without a proboscis. Three or four days after pairing, each female lays a single egg under loose bark. From these winter eggs apterous females are again hatched in the spring. These either attack the leaves, where they form galls on the under surface, or make their way down to the roots to reproduce their species in the manner already described. The progeny of the aphides living in the galls also sooner or later betake themselves to the roots. In Europe leaf galls are seldom found, whilst in America this was said to be the only evidence of injury to the vines which had been noticed.

It is natural that a remedy should have been early sought for to combat such an evil. The French Government first offered a prize of 300,000 francs, and later one of half-a-million, for the discovery of an effectual means of destroying the phylloxera, but hitherto without result. All that can be done is the complete destruction of the infested vines in the following manner:—

Dig up the diseased vines, soak them in petroleum and burn the whole. The infested ground should be treated with bisulphide of carbon, and must not be used for cultivating vines for four or five years. When possible the ground may be laid under water for about a month, which is said to have good results.

To guard against the danger of phylloxera, it is now common to plant vines which have been grafted on American sorts, as these have stronger roots and a more hardy growth. The vines should also be well manured.

But prevention is better than cure, hence it is necessary strictly to forbid the introduction of foreign vines, especially roots, and of such plants as have stood in the vicinity of vines; to restrict traffic in vines to limited districts, and ensure the inspection and control of vineyards by specialists.

A Vine Weevil (*Otiorhynchus ligustici*, Linn.)

Plate 31, *fig.* 1.

This stout, blackish weevil, with the wing-cases scaled with yellowish grey, and a thick short proboscis, attacks the expanding buds of vines, as well as the flowers and young shoots of peach-trees. It is however very fond of lucerne, and it is therefore useful to sow lucerne near fruit trees, as the beetles are attached to it, and can easily be swept up with a net and destroyed.

The best method of dealing with the weevil on peach trees and vines is to shake them down into an open umbrella. This may be done in the brightest sunshine, as they are devoid of membranous wings, and consequently incapable of flight.

Another Vine Weevil (*Rhynchites betuleti*, Fabr.)

Plate 31, *fig*. 2.

The care which this weevil takes in providing for its young is marvellous. It is twice as large as the stalk-boring weevil, figured on *plate* 16, *fig*. 1, and is of a steel-blue or golden-green colour. It prepares cigar-like rolls from the leaves of the vine, pear and other trees, having previously caused them to wither by notching the stalks, and inserts from one to six eggs between the leaves. The footless larvæ live in the roll for about four weeks, when they enter the ground to undergo their transformations.

When the beetles are sufficiently numerous to be injurious, they may be shaken from the trees into an umbrella, and the rolls of leaves may be collected.

The Vine Scale Insect (*Lecanium vitis*, Linn.)

Plate 31, *fig.* 3.

The female of this insect forms an oval or semi-circular plate of a reddish brown colour punctured with black. If a white cushion appears under the plate it shows that the animal is dead, and in its place are innumerable red eggs in a white flocculent mass. The little reddish males are only met with singly, and only for a short time in spring. They have two delicate wings and two long abdominal bristles. Strongly growing vines seldom suffer from these insects.

When necessary these *Coccidæ* may be destroyed in the same way as *Aphidæ*.

The Vine Tortrix (*Conchylis ambiguella*, Hübn.)

Plate 32.

This is a dangerous foe to the vine. When the first green leaves begin to appear on the vine, this little moth will be found in the morning and evening fluttering around them, and laying its white eggs singly on the young buds. The young caterpillar spins several buds together, eats them out, and then proceeds further. It feeds thus for two or three weeks at the time of the hay harvest. In June it pupates in a silken cocoon in its feeding place. The second brood of the moth appears at the beginning of July, and, finding the young grapes, lays its eggs among them, usually on the stalks.

The caterpillars now bore into the grapes, which betray their presence by a blue spot. The still milky stones are the especial favourites of the caterpillars, and, in order to reach them, they attack one grape after another, spinning threads as they proceed. Dew and rain are intercepted by the webs, and the damp produces a sour fermentation in the injured grapes. In October, after each caterpillar has destroyed a considerable number of grapes, they turn to pupæ, not among the grapes and leaves, but in cracks of the bark or of the props, or among straw, etc.

These pupæ hibernate.

The vine tortrix reduces the yield of vines so much that the following regulations are insisted upon by the authorities in some of the German wine-growing districts:—

(1.) The winter pupæ should be destroyed by removing the dead bark both from the vines and the props, and by burning all refuse, such as straw used in binding up the vines, etc., during the previous year.

(2.) The moths may be attracted by a number of small lights surrounded with paper shades spread with bird lime.

(3.) To keep away the moths from the sprouting vines and to destroy their larvæ, their webs should be sprinkled with a weak solution of caustic potash—one per cent. is sufficient.

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Hyponomeuta malinella, 96

Lecanium vitis, 131

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Rhizotrogus solstitialis, 56
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—— vulgaris, 111

Zabrus gibbus, 52

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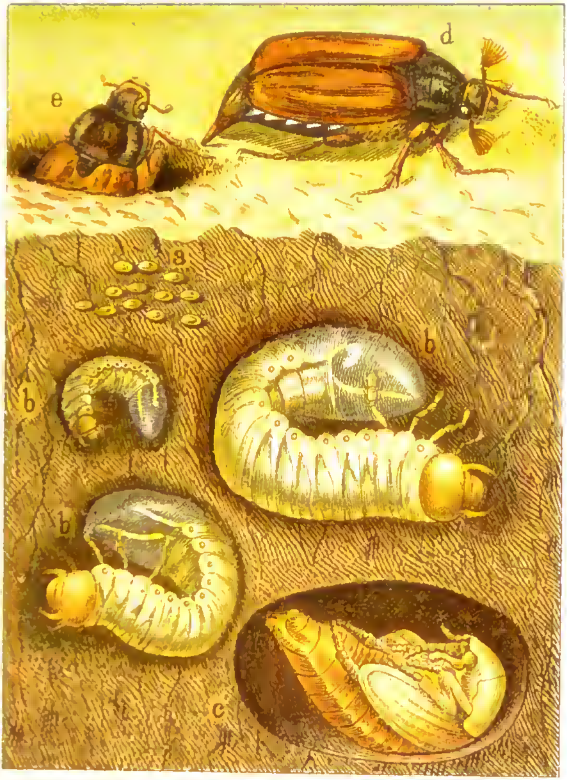
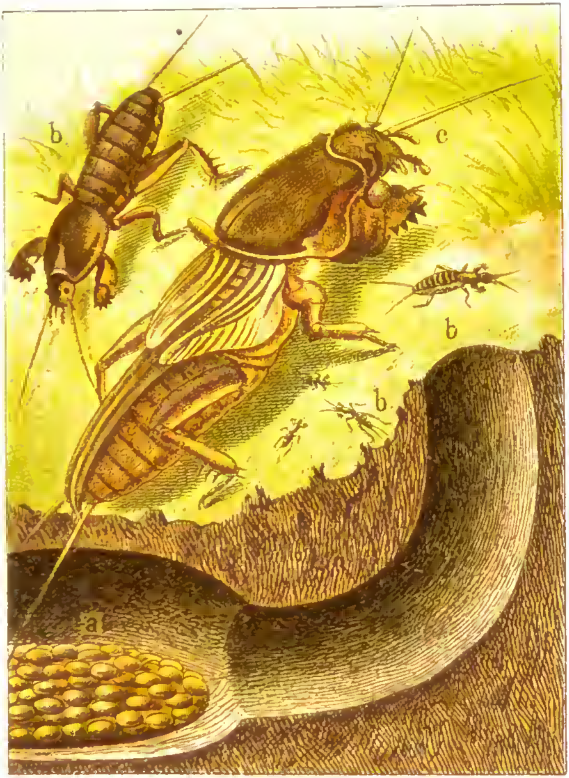
Plate 1.



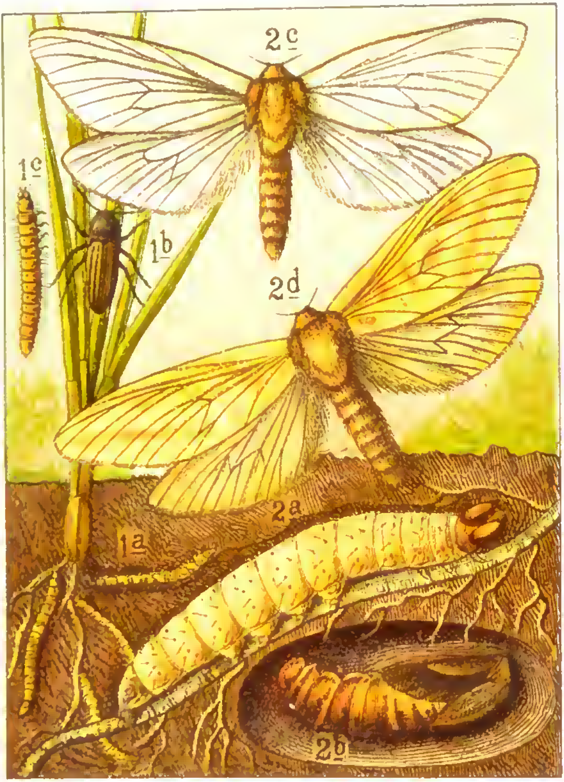
Cockchafer: a Eggs; b Grubs; c Pupa, d Male Beetle; e Female Beetle.

Plate 2.



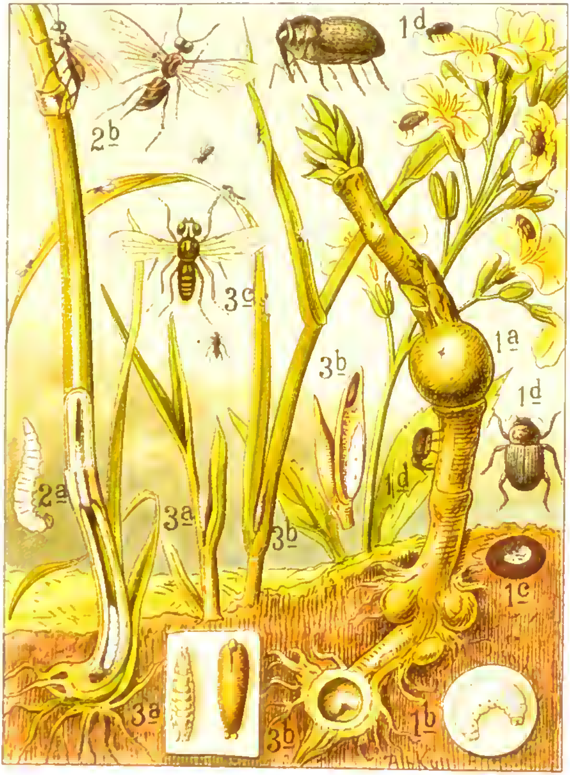
Mole Cricket: a Eggs; b Larvae; c The Perfect Insect.

Plate 3.



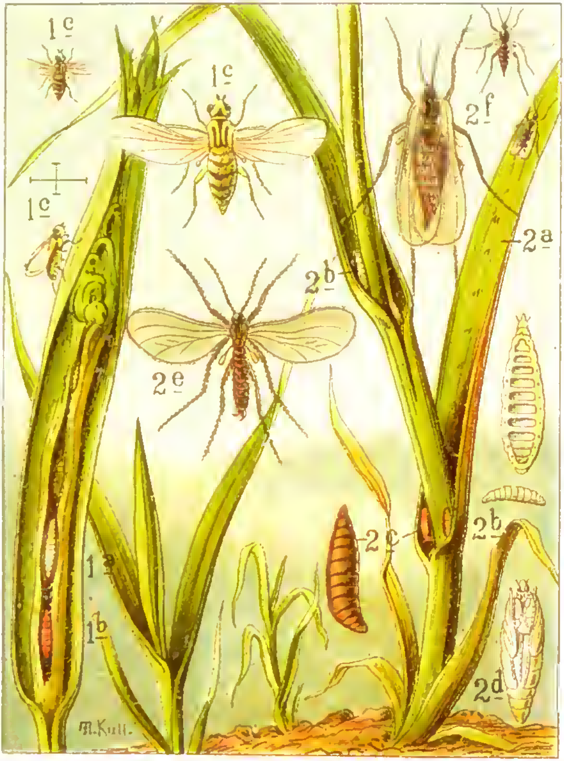
1. Striped Click-beetle: a Wire Worms; b The Beetle. 2. Ghost Moth: a Caterpillar; b Chrysalis; c Male Moth; d Female Moth.

Plate 4.



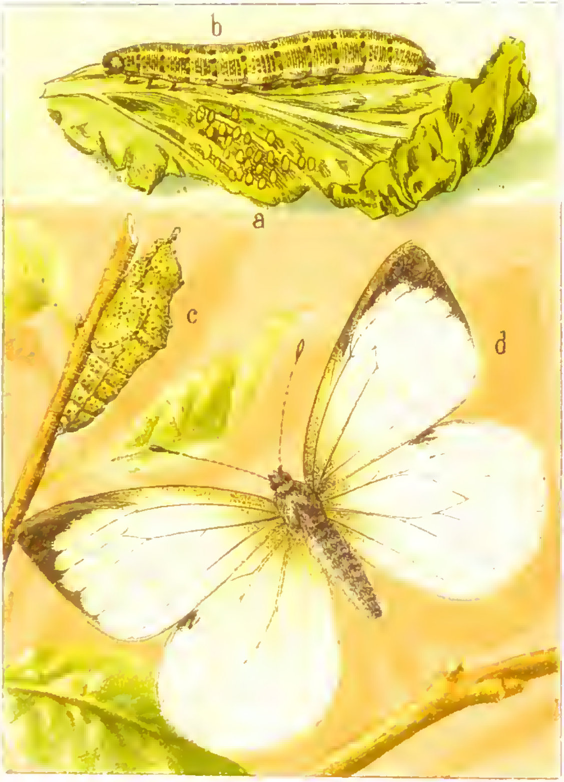
1. **Turnip-Gall Weevil**: a Stalk showing galls; b Larvae; c Pupa; d Beetle. 2. **Corn Saw-fly**: a Larvae; b Flies. 3. **Frit Fly**: a Larvae; b Pupae (with case); c Flies. All figures natural size and magnified.

Plate 5.



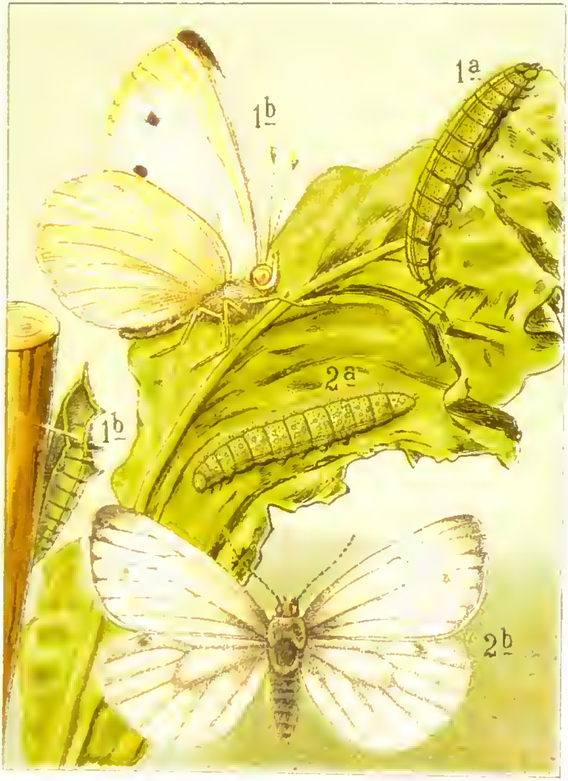
1. **Ribbon-footed Corn-fly**: a Larva; b Pupa; c The Fly (magnified). 2. **Hessian Fly**: a Eggs; b Larvae in different stages (nat. size and magnified); c Pupa case; d Pupa; e Male Fly (magnified); f Female Fly (nat. size and magnified).

Plate 6.



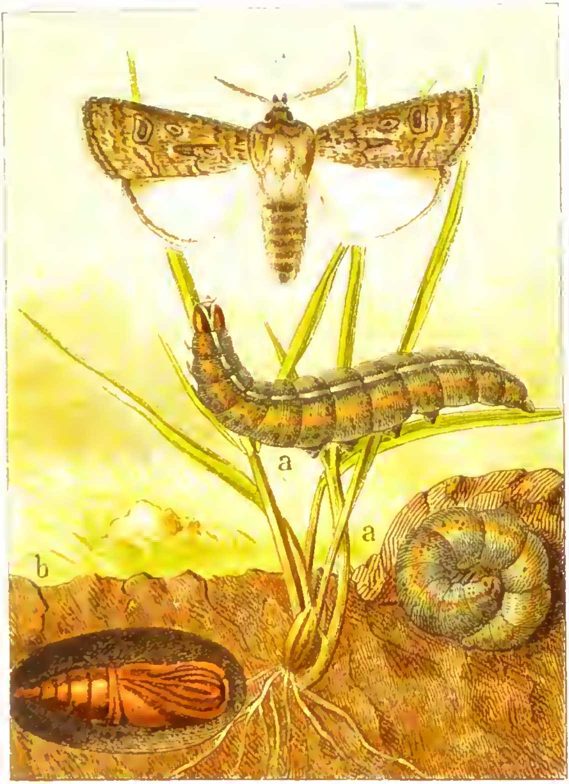
Large Cabbage White Butterfly: a Eggs; b Caterpillar; c Chrysalis; d Butterfly.

Plate 7.



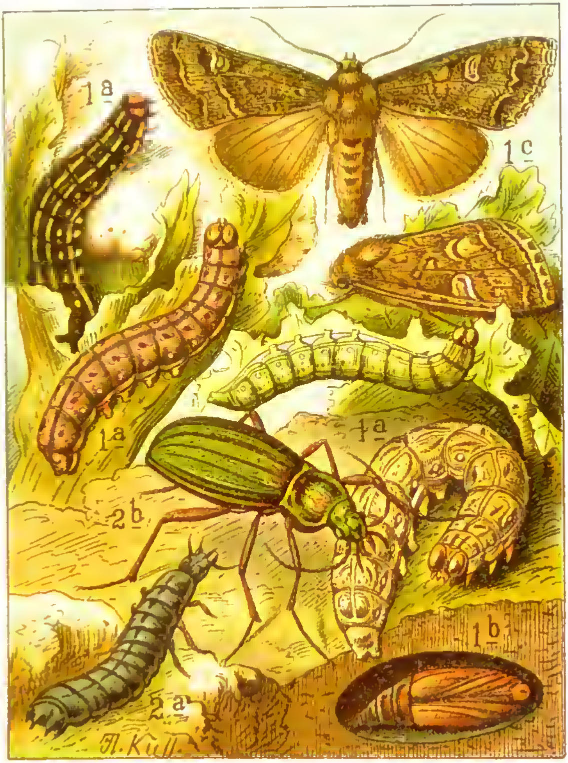
1. Small Cabbage White Butterfly: a Caterpillar; b Chrysalis; c Butterfly. 2. Green-veined White Butterfly: a Caterpillar; b Butteflry.

Plate 8.



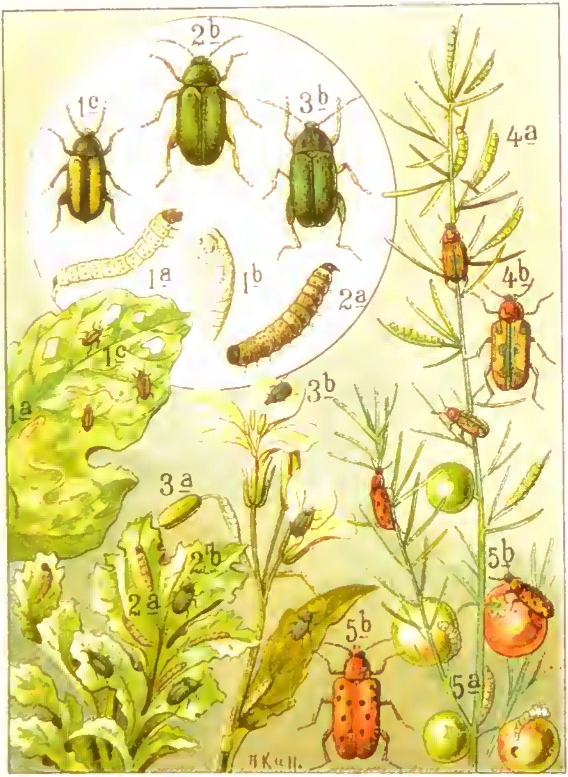
Turnip Moth: a Caterpillars, b Chrysalis; c Moth.

Plate 9.



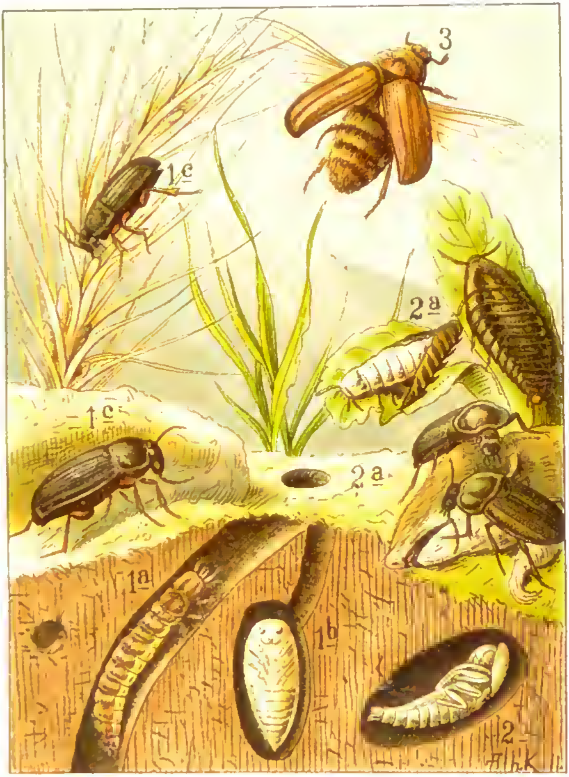
Cabbage Moth: a Varieties of the caterpillar; b Chrysalis; c Moth. 2. Gold Beetle: a Larva; b Beetle.

Plate 10.



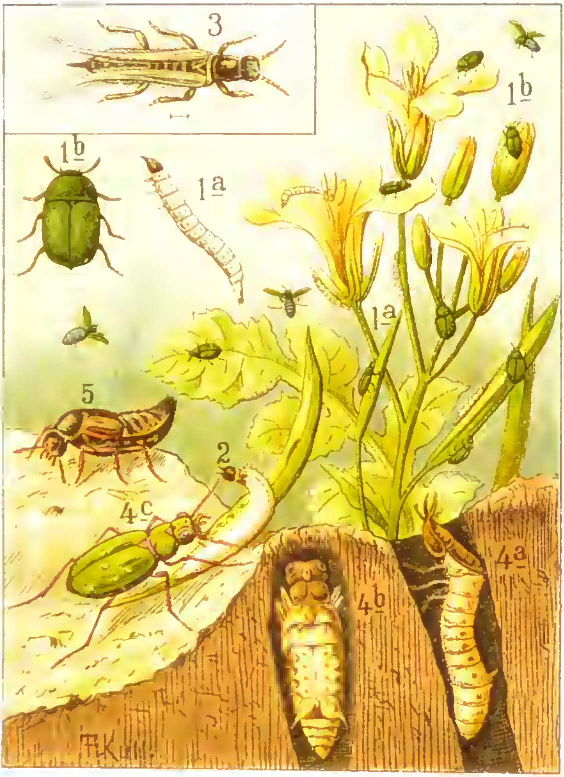
1. **Striped Turnip-Beetle**: a Larva; b Pupa; c Beetle. 2. **Cabbage Flea-Beetle**: a Larvae; b Beetle. 3. **Rape Flea-Beetle**: a Larvae; b Beetle. 4. **Asparagus Beetle**: a Larvae; b Beetle. 5. **Twelve-spotted Asparagus Beetle**: a Larvae; b Beetle (nat. size and magnified).

Plate 11.



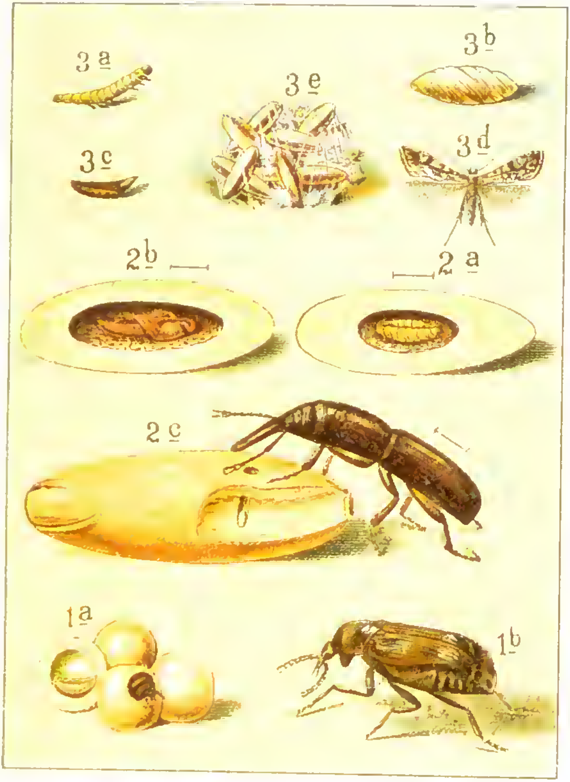
1. **Wheat Ground Beetle**: a Larva; b Pupa; c Beetle. 2. **Black Carrion Beetle**: a Larvae (one moulting); b Pupae; c Beetles. 3. Small Chafer.

Plate 12.



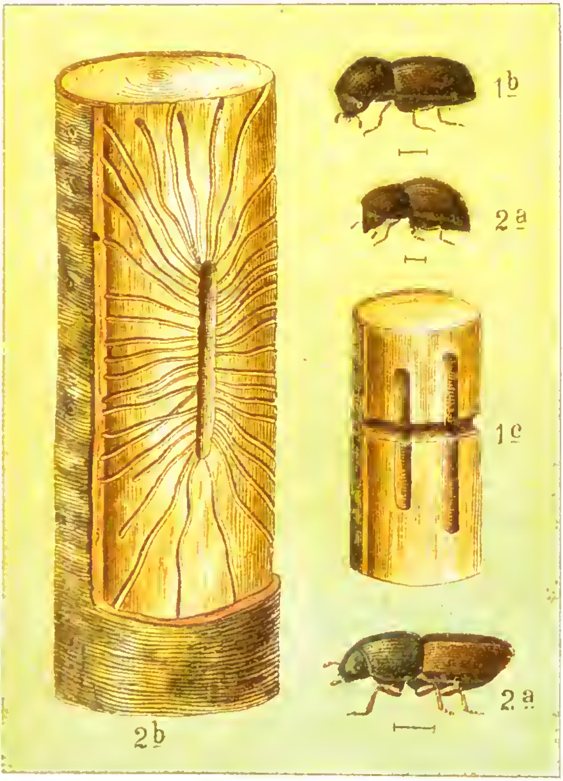
1. Rape Flower Beetle: a Larvae; b Beetle (nat. size and magnified); 2. Caterpillar of Clouded-yellow Pearl Moth. 3. Corn Thrips. 4. Green Tiger Beetle: a Larva; b Pupa; c Beetle. 5. Rove Beetle.

Plate 13.



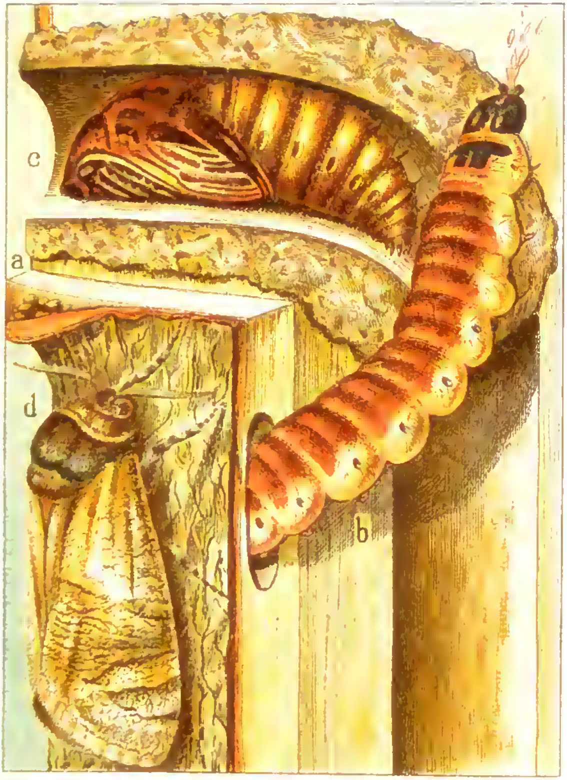
1. **Pea Beetle**: a Peas showing Larva and emerging Beetle; b Beetle (magnified). 2. **Corn Weevil**: a Larva; b Pupa; c Beetle and Egg (magnified). 3. **Corn Moth**: a Caterpillar; b Cocoon; c Chrysalis; d Moth; e Infested Grain.

Plate 14.



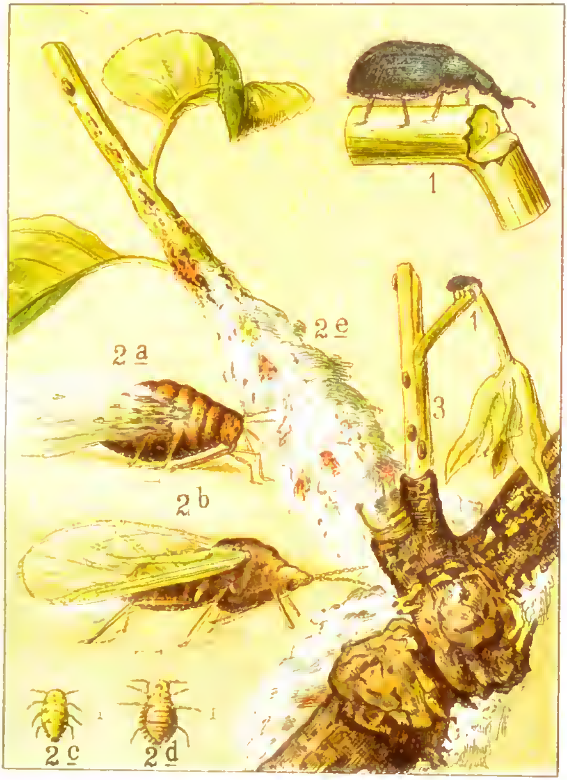
1. **Bark Beetle**: a Male; b Female; c Galleries in a young apple stem. 2. **Plum-tree Borer**: a Beetle; b Galleries under bark of Fruit-tree. -- The Beetles are magnified.

Plate 15.



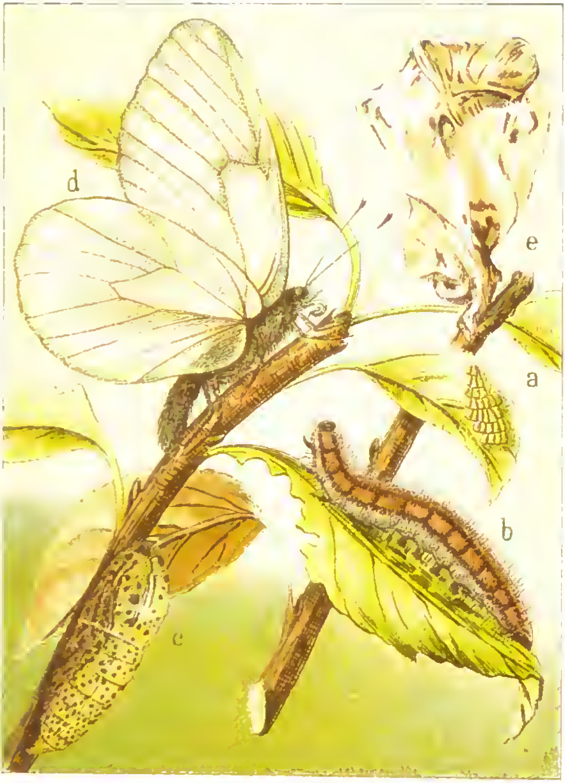
Goat Moth: a Eggs; b Caterpillar; c Chrysalis in opened Cocoon; d Moth.

Plate 16.



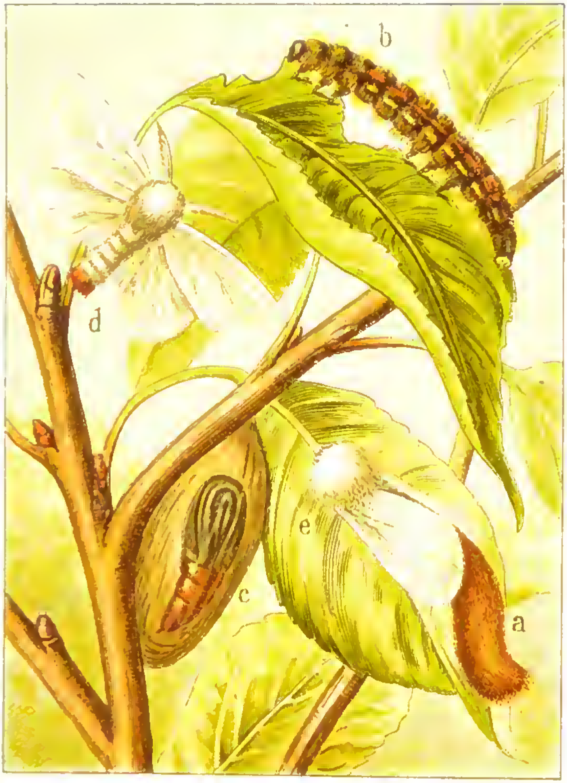
1. **Stalk-boring-Weevil** (nat. size and magnified). 2. **Woolly Aphis**: a Wingless Form; b Winged Form; c Male; d Female; e American Blight. a—d are magnified. 3. **Apple Aphis.**

Plate 17.



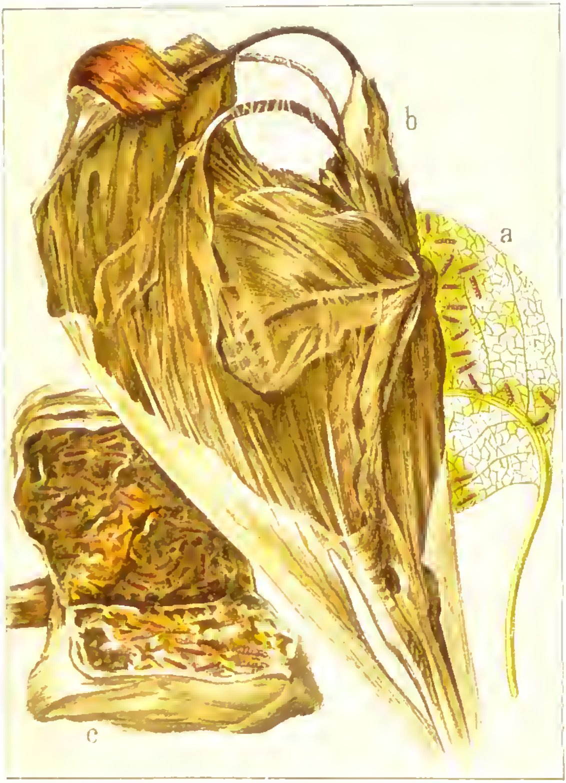
Black-veined White Butterfly: a Eggs; b Caterpillar; c Chrysalis; d Butterfly; e Caterpillar's Nest.

Plate 18.



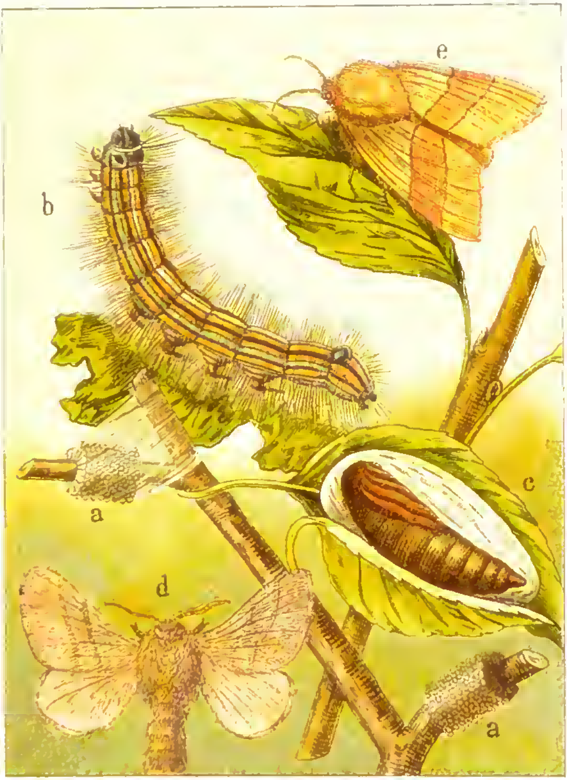
Brown-tail Moth: a Egg Mass; b Caterpillar; c Chrysalis; d Male Moth; e Female Moth.

Plate 19.



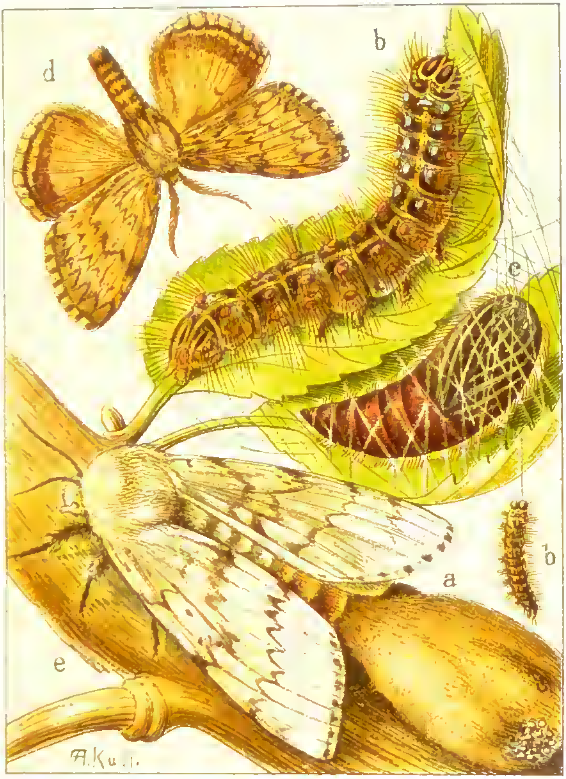
Brown-tail Moth: a Young Caterpillars; b Caterpillar's Nest; c Section of Nest.

Plate 20.



Lackey Moth: a Eggs; b Caterpillar; c Chrysalis; d Male Moth; e Female Moth.

Plate 21.



Gipsy Moth: a Egg Mass; b Caterpillars; c Chrysalis; d Male Moth; e Female Moth.

Plate 22.

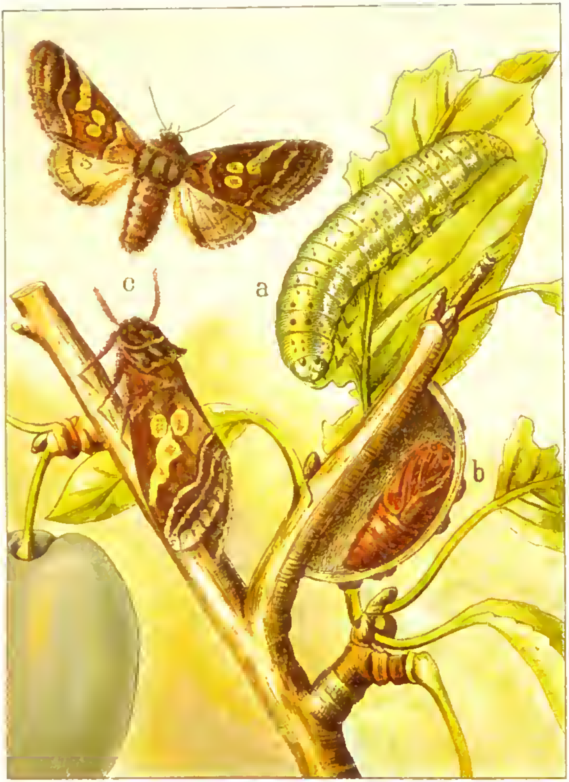
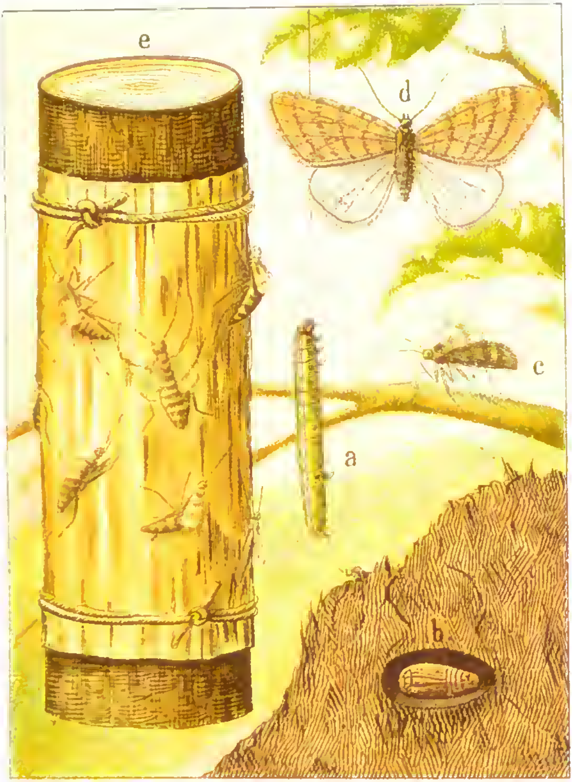


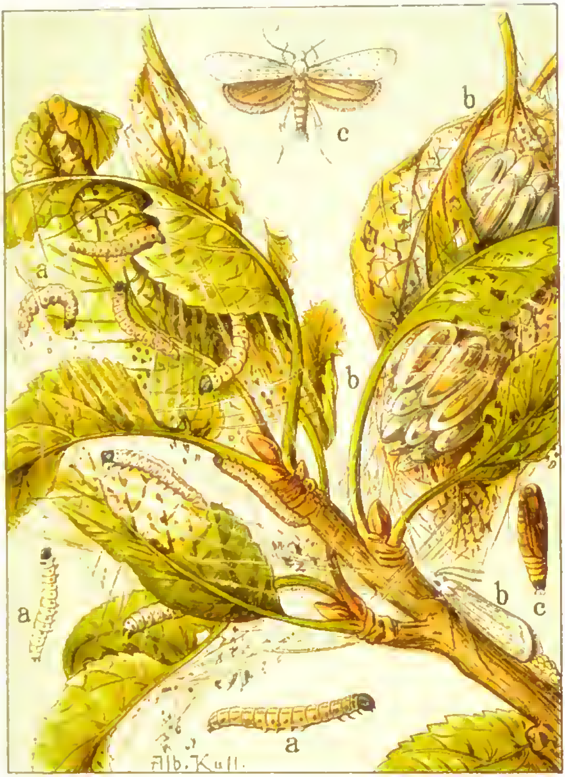
Figure of 8 Moth: a Caterpillar; b Chrysalis; c Moths.

Plate 23.



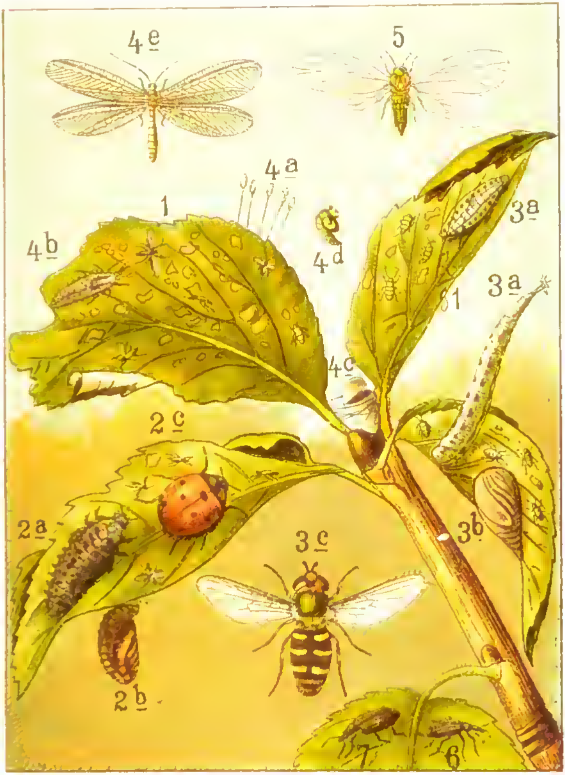
Winter Moth: a Caterpillar; b Chrysalis; c Female Moth; d Male Moth; e Trunk of Tree showing trap.

Plate 24.



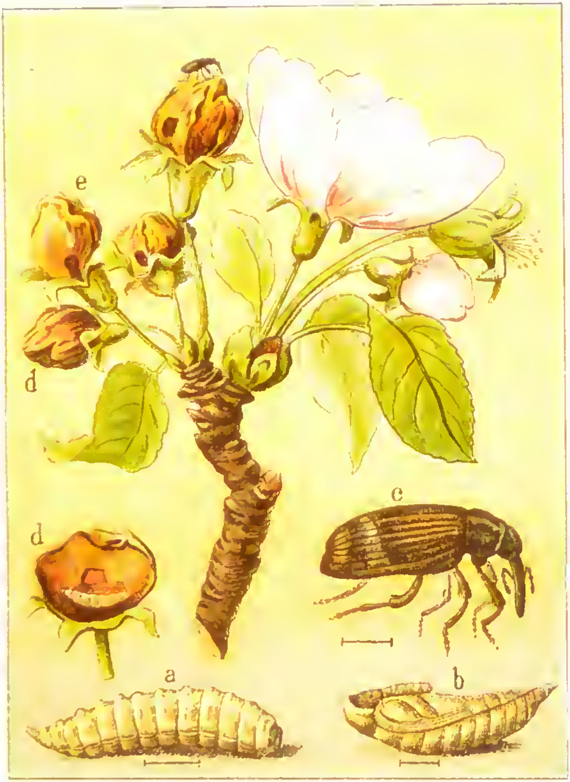
Small Ermine Moth of Apple: a Caterpillars; b Cocoons; c Chrysalis; d Moths (the lower figure shown depositing eggs).

Plate 25.



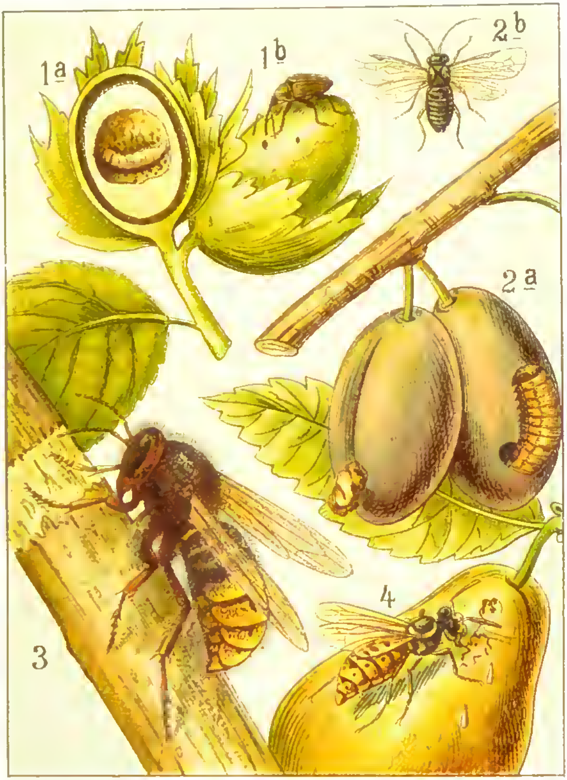
1. Plant Louse. 2. Seven Spot Lady Bird: a Larva; b Pupa; c Beetle. 3. Hover Fly: a Larva; b Pupa; c Fly. 4. Lace Winged Fly: a Eggs; b Larva; c Cocoon; d Pupa; e Perfect Insect. 5. Pear Chermes. 6. Oblong Weevil. 7. Silvery Weevil.

Plate 26.



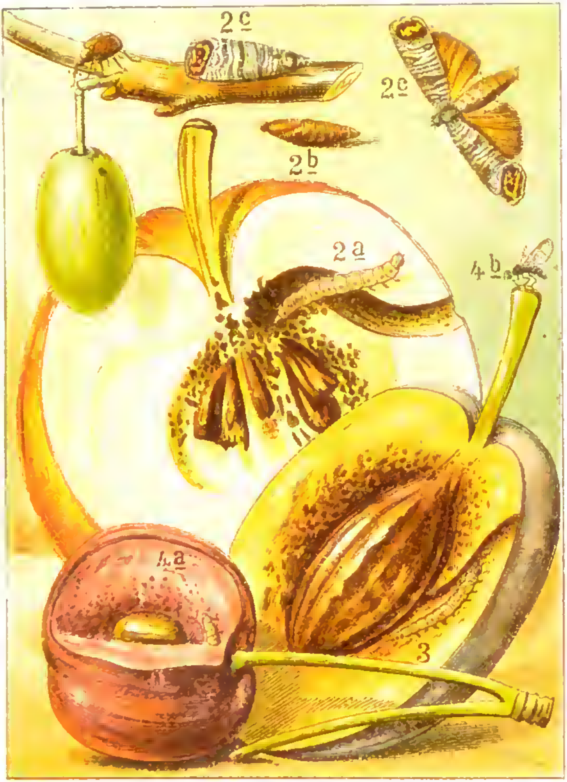
Apple-blossom Weevil: a Larva; b Pupa; c Beetle; d Infested Bud; e Deserted Bud. a—c magnified.

Plate 27.



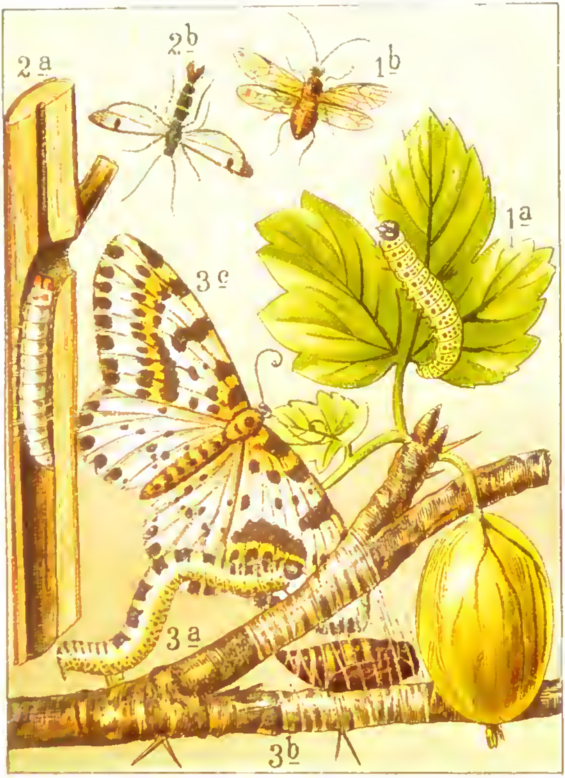
1. **Nut Weevil**: a Larva; b Beetle depositing Eggs. 2. **Plum Saw-fly**: a Larva (magnified); b Saw-fly. 3. **Hornet** attacking Bark. 4 **Common Wasp**.

Plate 28.



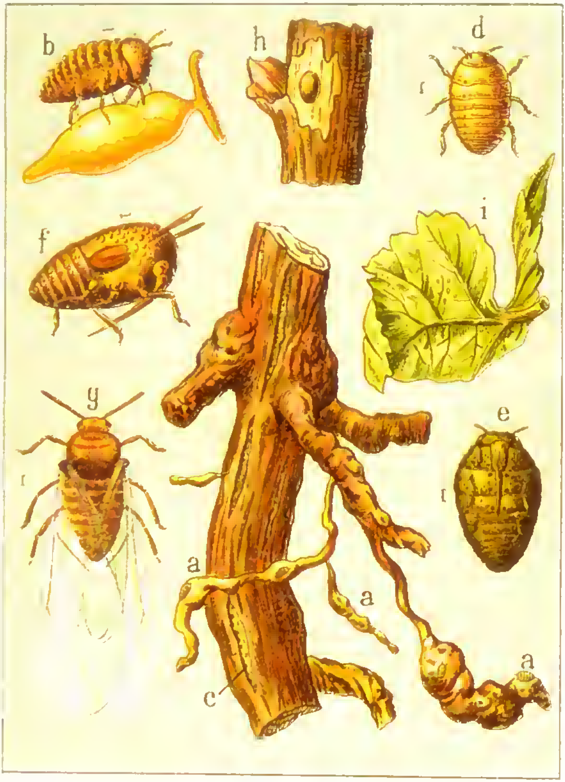
1. Plum Weevil. 2. Codling Moth: a Caterpillar; b Chrysalis; c Moth. 3. Caterpillar of Plum Moth. 4. Cherry Fly: a Larva; b Fly.

Plate 29.



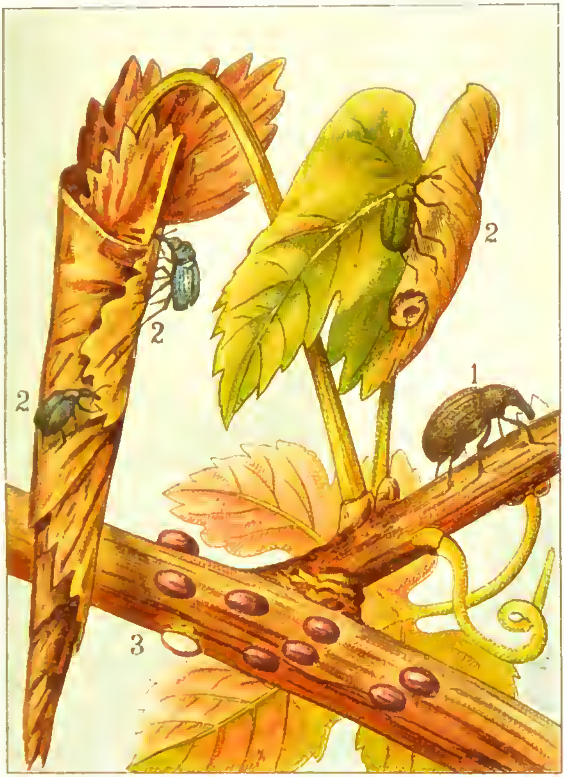
1. Yellow Gooseberry Saw-fly: a Larva; b Fly. 2. Currant Clearwing: a Caterpillar; b Moth. 3. Magpie Moth: a Caterpillar; b Chrysalis; c Moth.

Plate 30.



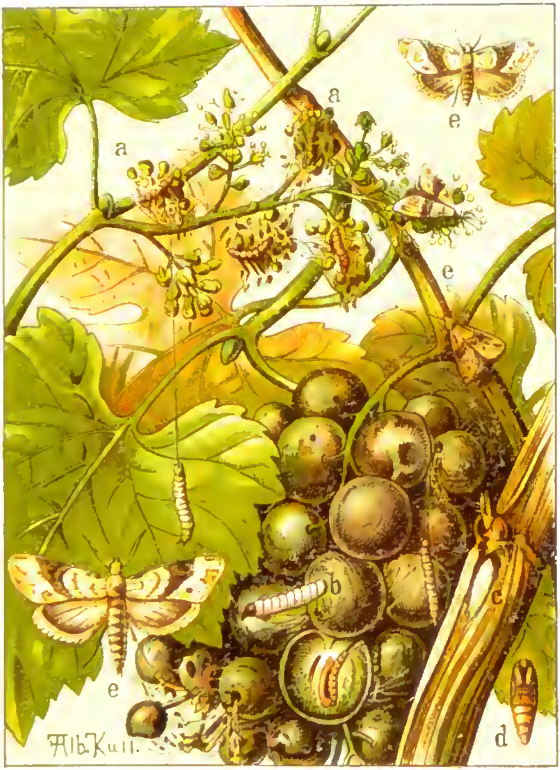
Vine Aphis: a Infested roots with nodosities; b Aphis feeding; c Hibernating Aphidae; d Young Aphis; e Adult Aphis; f Nymph; g Winged Aphis; h Winter quarters; i Leaf with Aphidae. b and d—h are magnified.

Plate 31.



1, 2 Vine Weevils. 3. Vine Scale Insect.

Plate 32.



Vine Tortrix: a Summer Brood of Larva; b Autumn Brood of Larva; c Cocoon; d Pupa; e Moth (nat. size and magnified.)

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